Anatomy Hand-out

LOWER LIMB



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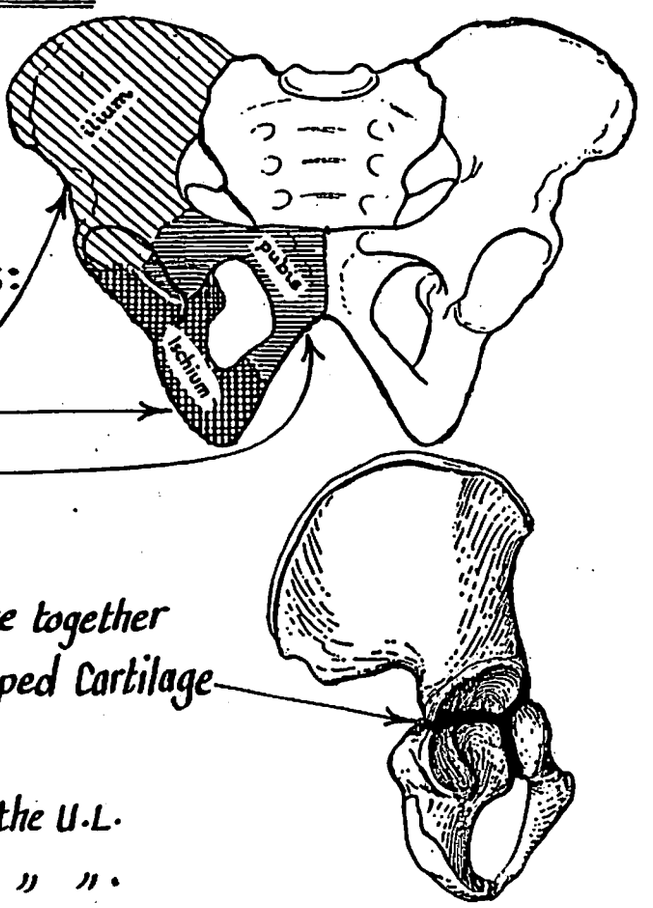
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1- THE HIP BONE



* It is a large irregular bone forming the skeleton of the hip & the buttock.
* The 2 hip bones constitute the pelvic girdle

* Structure : it is formed of 3 parts:

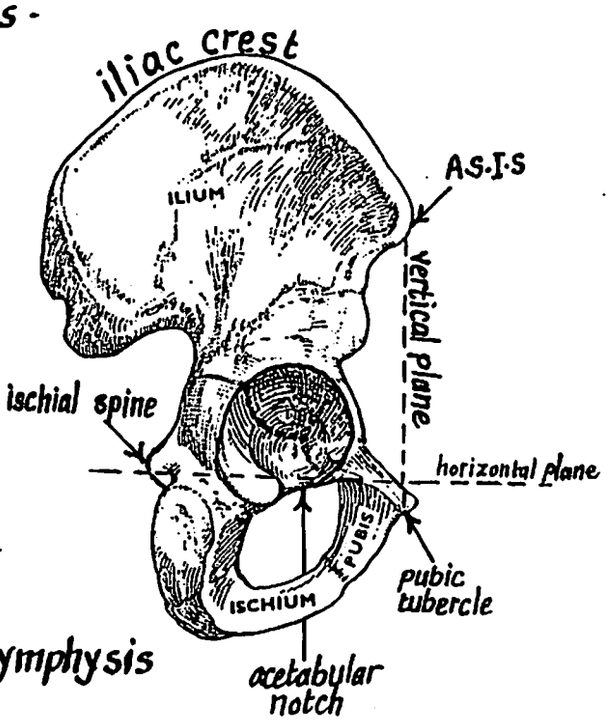
(1) **Ilium**: the superior expanded part.
(2) **Ischium**: the postero-inferior part.
(3) **Pubis** : the antero-inferior part.

N.B:

(1) the 3 constituent bones of the hip unite together in the region of the acetabulum by Y-shaped cartilage which ossifies at the age of puberty.
(2) the ilium corresponds to the scapula in the U.L.
(3) the pubis " " " clavicle " " ".
(4) the ischium " " " coracoid process.

* Side determination (Rt. or Lt.):

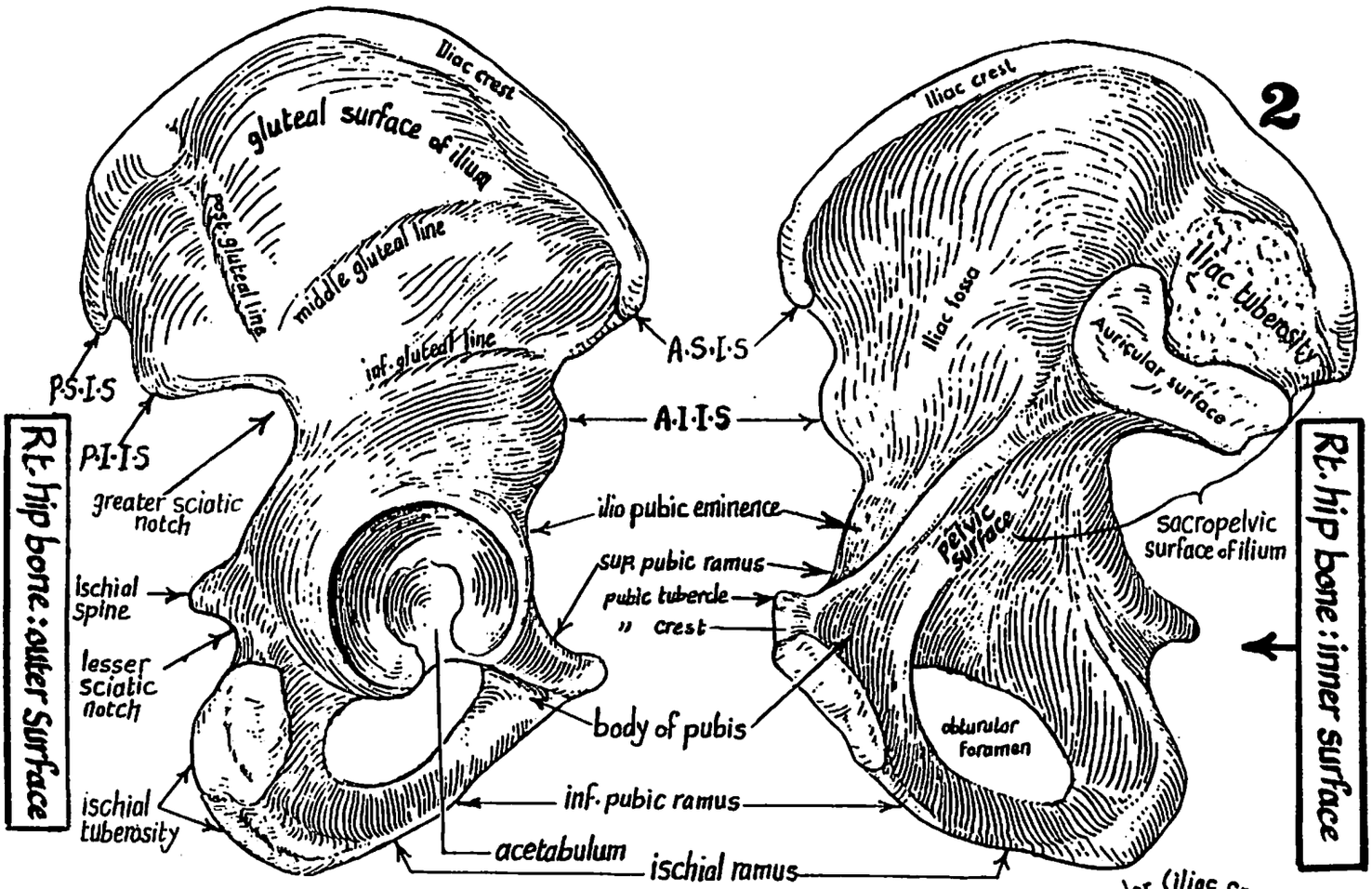
(1) the iliac crest lies above.
(2) the obturator foramen lies below.
(3) the acetabulum is directed laterally.
(4) the ischial tuberosity lies postero inferiorly.



* Anatomical position of the hip bone:

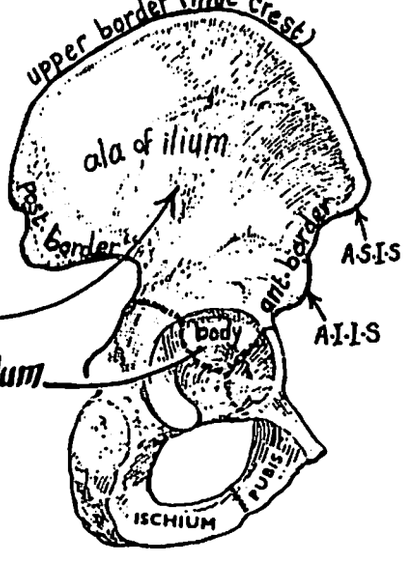
(1) the ant. sup. iliac spine (A.S.I.S) & the pubic tubercle lie in the same vertical plane.
(2) the ischial spine & the upper border of the symphysis pubis lie in the same horizontal plane.
(3) the acetabular notch faces downwards.

N.B: the description that follows applies to the hip bone in this anatomical position.



General features of the hip bone

I- The ILIUM



★ **Structure**: it is formed of:

(1) Ala of ilium: the flat bony plate above the acetabulum

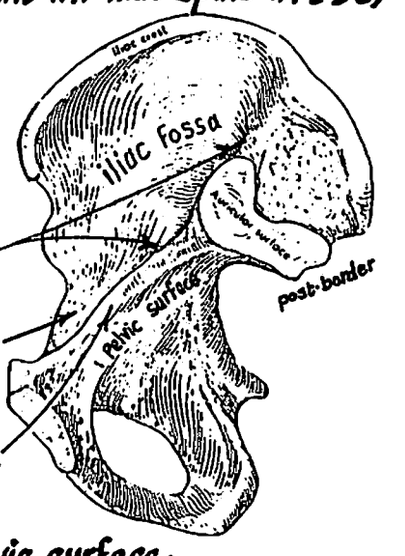
(2) body " " : the lower part forming the sup. 2/5 of acetabulum

★ **Borders of ilium**: 4: ant., post., med. & superior:

(1) the ant. border:
- begins at the ant. sup. iliac spine (A.S.I.S).
- it descends downwards forming a notch then forms the ant. inf. iliac spine (A.I.I.S).
- it ends below at the acetabulum.

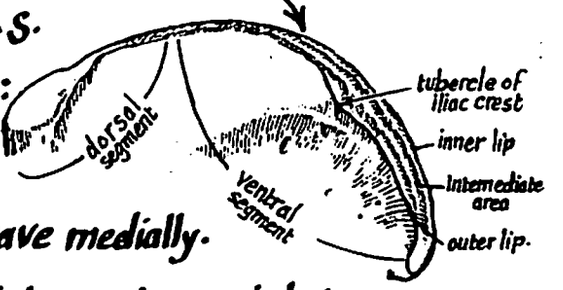
(2) the post. border:
- it begins at the post. sup. iliac spine (P.S.I.S).
- it forms the post. inf. iliac spine (P.I.I.S) & ends by forming the upper part of the greater sciatic notch.

(3) the medial border:
- it begins near the iliac crest forming the ant. border of the auricular surface then it forms the arcuate line which extends to the ilio-pubic eminence.
- this border separates the iliac fossa from the sacropelvic surface.



- the Sup. border : **Iliac crest** :

* it begins at the A.S.I.S & ends at the P.S.I.S.
* it is divided into ventral & dorsal segments :



(A) the Ventral Segment:

- it constitutes about 2/3 of the crest & is concave medially.
- it is formed of outer & inner lips & intermediate rough area in between.
- the outer lip carries a prominence called tubercle of iliac crest 2" behind the A.S.I.S.

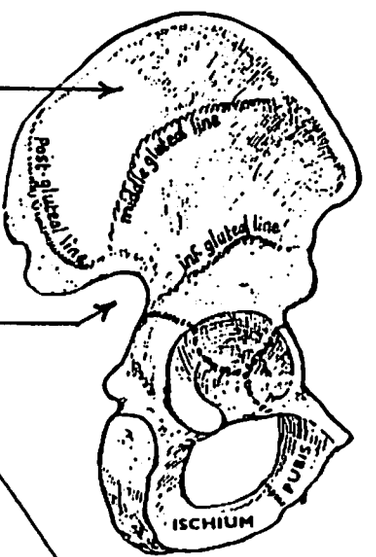
(B) the dorsal Segment :

- constitutes the post. 1/3 of the crest & is concave laterally.
- it is formed of outer & inner sloping areas separated by a ridge

* **Surfaces of ilium**: 3 : gluteal surface, iliac fossa & sacropelvic surface :

(1) the Gluteal Surface :

- it is the outer rough surface of the ilium
- it is divided into 4 parts by 3 gluteal lines: post., middle & inferior converging towards the greater sciatic notch

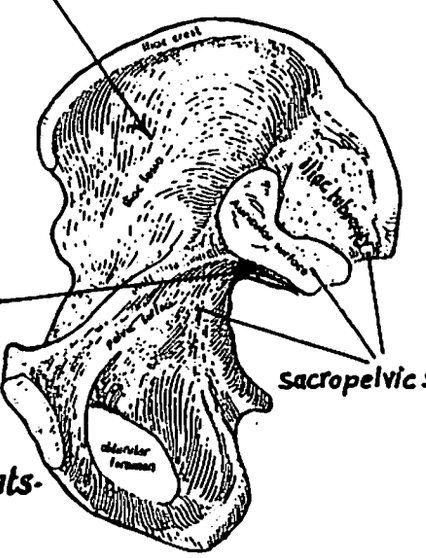


(2) the Iliac fossa :

It is the large concave area on the inner surface of ilium.

(3) the Sacro-pelvic Surface :

- it is the uneven area on the inner surface of ilium which lies below & behind the iliac fossa & separated from it by the med. border of ilium.
- it is subdivided into 3 parts :



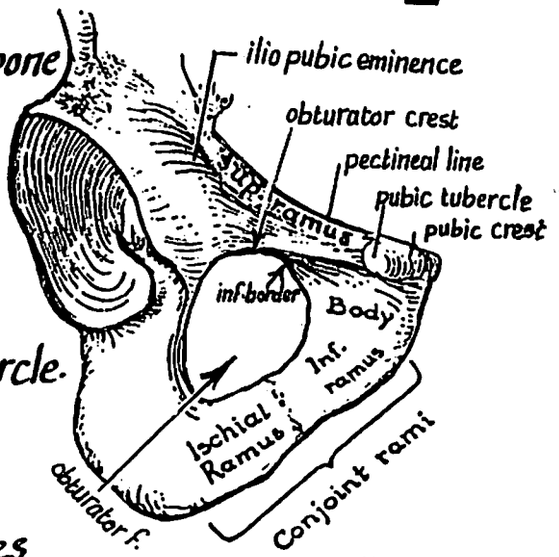
(a) iliac tuberosity : it is the post. rough area found below the dorsal segment of the iliac crest. It gives attachment to the interosseous & dorsal sacroiliac ligaments.

(b) auricular surface : lies infront of the iliac tuberosity
- it articulates with the auricular surface of the sacrum in the sacroiliac joint.

(c) pelvic surface : lies antero-inferior to the auricular surface. It shows a groove called the pre auricular sulcus along the upper border of the greater sciatic notch. The sulcus is deeper in the female than in the male.

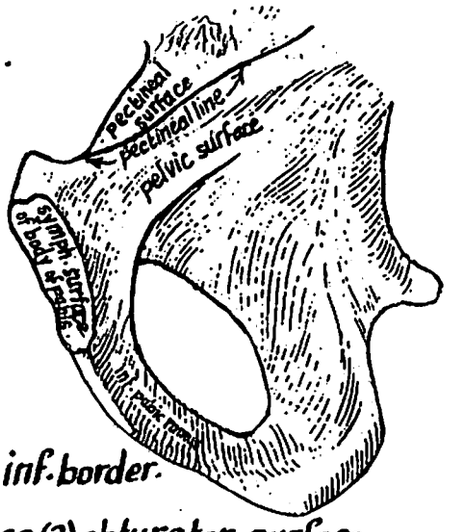
II- The Pubis

* It constitutes the anteroinferior part of the hip bone
* It is formed of a body & 2 rami : sup. & inferior.



(A) The body of pubis: it is flattened & has:

(1) an upper border: called **pubic crest** which ends laterally by the pubic tubercle.
(2) **anterior** or femoral surface.
(3) **posterior** or pelvic surface.
(4) **medial** or symphyseal surface which articulates with opposite pubis to form the pubic symphysis.



(B) Superior pubic ramus:

- it extends superolaterally to join the ilium at the iliopubic (ilio-pectineal) eminence.
- its lat. end forms 1/5 of the acetabulum.
- it has 3 borders & 3 surfaces:
 - the borders are: (1) pectineal line (2) obturator crest (3) inf. border.
 - the surfaces are: (1) pectineal surface (2) pelvic surface (3) obturator surface or groove.

(C) Inferior pubic ramus:

- it extends posteroinferiorly from the body of pubis to join the ischial ramus forming the conjoined ischiopubic ramus (fusion occurs at the age of 7 years).
- it has 2 borders (med. & lat.) and 2 surfaces (outer & inner).

N.B: the inf. pubic ramus is everted in the male due to attachment of the crus of the penis

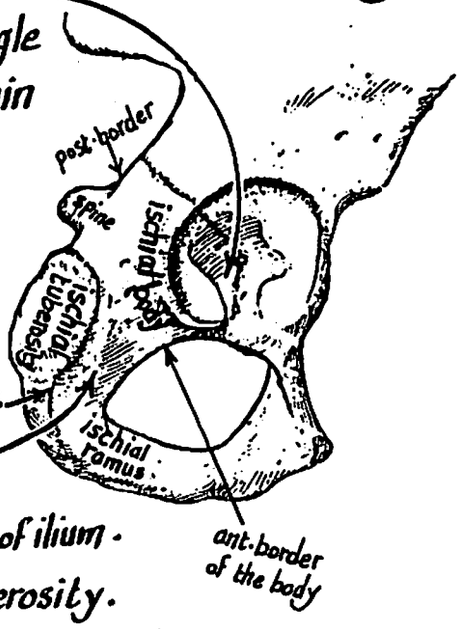
III- The Ischium

- It forms the posteroinferior part of the hip bone & the adjoining 2/5 of the acetabulum
- it consists of a body, a tuberosity & a ramus.

(A) Ischial body:

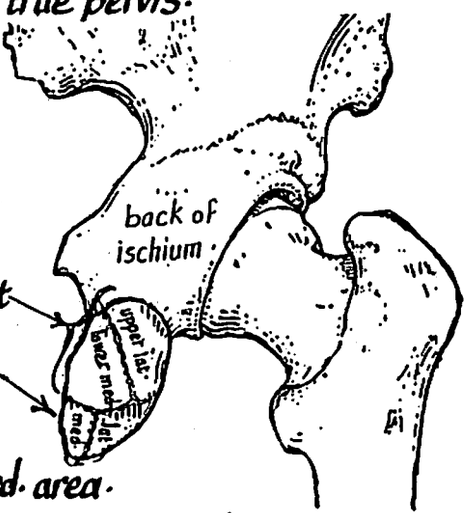
- it is the thick part lying below & behind the acetabulum.
- it has: 2 ends (upper & lower), 3 borders (ant. / post / lateral) & 3 surfaces (femoral / dorsal / pelvic)

- the upper end: forms the posteroinf. 2/5 of the acetabulum.
- the lower end: gives rise to the ischial ramus at an acute angle
- the ant. border forms the post. part of the obturator margin
- the post. border: continuous with the post. border of ilium. it forms the lower part of the greater sciatic notch then projects to form the ischial spine, below which it presents the lesser sciatic notch.
- the lateral border: forms the lateral margin of the ischial tuberosity.
- the femoral surface: lies between the ant. & lateral borders
- the dorsal surface: continuous above with the gluteal surface of ilium. Below, it projects to form the ischial tuberosity.
- the pelvic surface: is smooth & forms part of the lat. wall of the true pelvis.



B- Ischial tuberosity:

- it is a very strong piece of bone which projects from the lower end of the body of ischium.
- it is divided by a transverse ridge into: upper quadrangular part & a lower triangular part
- the upper quadrangular part: is subdivided by an oblique ridge into upper lat. area & lower med. area.
- the lower triangular part: is divided by a longitudinal ridge into lat. area & med. area.

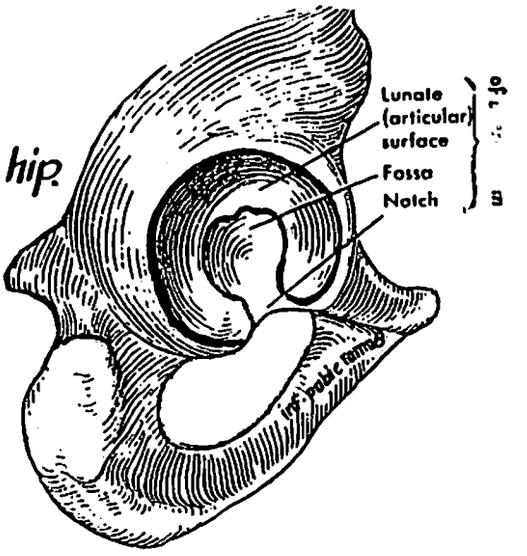


C- Ischial ramus:

- It projects from the lower end of the body of pubis.
- it joins the inf. pubic ramus to form the conjoined ischiopubic ramus.
- it has 2 borders (upper & lower) and 2 surfaces: outer (femoral) & inner (pelvic).

The Acetabulum

* It is a cup-shaped cavity on the lateral aspect of the hip
* It is directed laterally, downwards & forwards.
* its margin is deficient inferiorly by the acetabular notch which is bridged by the transverse acetabular lig.
* its concavity presents a horse-shoe shaped articular surface occupying the ant., sup. & post. parts & is called the lunate surface.



the lunate surface surrounds a non-articular articular depression called the acetabular fossa which is filled with fat (in the living).

N.B:

(1) the 3 parts of the hip bone meet together in the acetabulum:

- the pubis forms the ant. 1/5 of the lunate surface.
- the ilium forms the sup. 2/5 " " " "
- the ischium forms the post 2/5 " " " + the acetabular fossa.

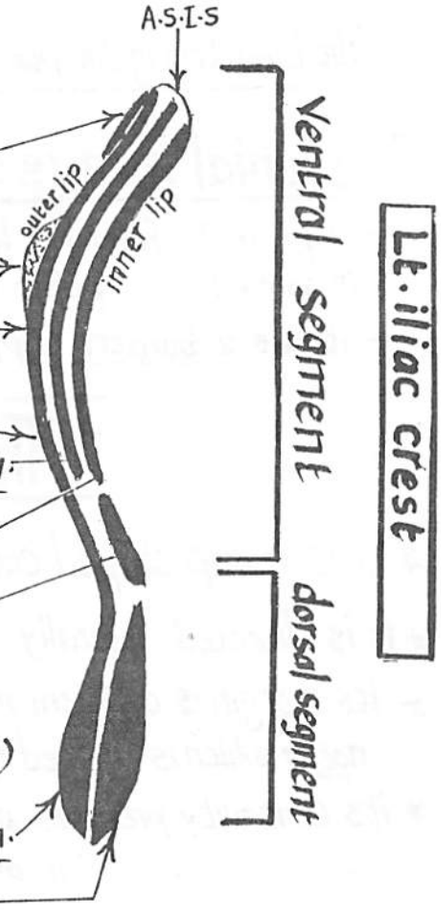
(2) the 3 bones remain separated by a Y-shaped cartilage till puberty.

The obturator foramen

* it is a large gap in the hip bone lying antero inferior to the acetabulum.
* it is bounded by the pubis & ischium only.
* in the living, it is incompletely closed by a membrane (obturator membrane). leaving a narrow passage called obturator canal.

Muscles & ligaments attached to the hip bone

I- the iliac crest



(A) Ventral Segment: (has outer & inner lips & intermediate area)

I- the outer lip:

(1) Tensor fascia lata m.: arises from its ant. part

(2) ilio-tibial tract: attached to the tubercle of iliac crest

(3) external abdominal oblique m.: is inserted into its ant. ½

(4) latissimus dorsi m: arises from its post. ½.

II- Intermediate area: gives origin to the internal abd. oblique m.

III- the inner lip:

(1) transversus abdominis m. arises from its ant. 2/3rd

(2) quadratus lumborm m. arises from its post 1/3rd

(B) Dorsal Segment: (has outer & inner sloping surfaces)

(1) the outer sloping surface gives origin to gluteus maximus m.

(2) the inner sloping surface gives origin to sacrospinalis m.

II- prominences of ilium & pubis

each of the following projections gives attachment to one muscle & one ligament:

(1) Ant. sup. iliac spine: origin of sartorius m. / attachment of lat. end of inguinal lig.

(2) Ant. inf. iliac spine: origin of straight head of rectus femoris m. / attachment of iliofemoral lig.

(3) Iliopubic eminence: insertion of psoas minor m. / attachment of pubofemoral lig.

(4) Pubic tubercle: insertion of cremasteric m. / attachment of med. end of the inguinal lig.

(5) Pubic crest: gives origin to rectus abdominis & pyramidalis muscles.

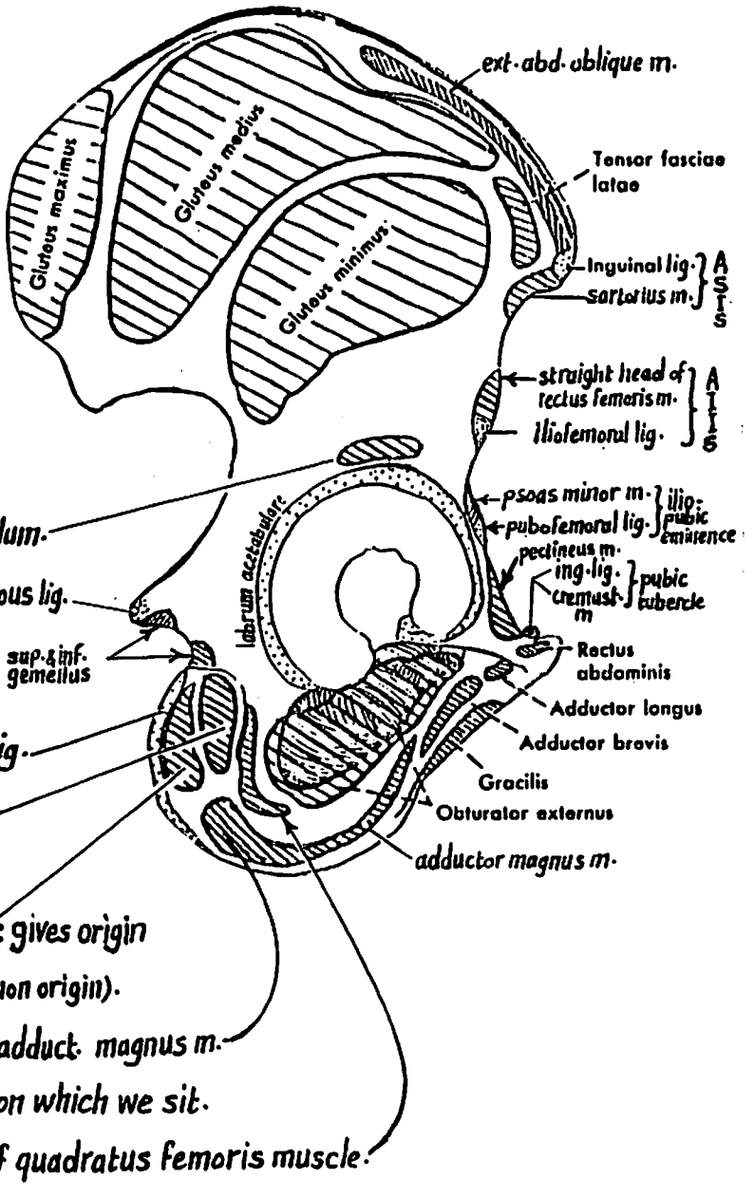
III- Gluteal Surface of ilium:

(1) gluteus maximus m.: arises behind the the post. gluteal line.

(2) gluteus medius m.: arises between the middle & post. gluteal lines.

(3) gluteus minimus m.: arises between the middle & the inf. gluteal lines

(4) reflected head of rectus femoris m.: arises from a groove above acetabulum.



IV- ischial spine: gives attachment to sacrospinous lig.

V- ischial tuberosity:

- lat. border gives attachment to sacrotuberous lig.
- upper lat. part of the quadrangular area: gives origin to semimembranosus m.
- lower med. part of the quadrangular area: gives origin to long head of biceps + semitendinosus (common origin).
- lat. part of the Δ area: origin of ischial part of adduct. magnus m.
- med. part of the Δ area: related to pad of fat on which we sit.
- med. border of the ischial tuberosity: origin of quadratus femoris muscle.

VI- Pubic bone:

(1) pectineus m.: arises from pectineal surface & line of sup. pubic ramus.

(2) adductor longus: arises from the front of body of pubis (just below pubic tubercle).

(3) adductor brevis: arises from front of body of pubis + inf. pubic ramus (below add. longus m.)

(4) adductor magnus (pubic part): arises from the conjoint ischiopubic ramus.

(5) Gracilis m.: arises from lower part of the pubic body (close to symphysis pubis).

(6) obturator externus m.: arises from outer surface of obturator memb. + lower margin of obt. foramen.

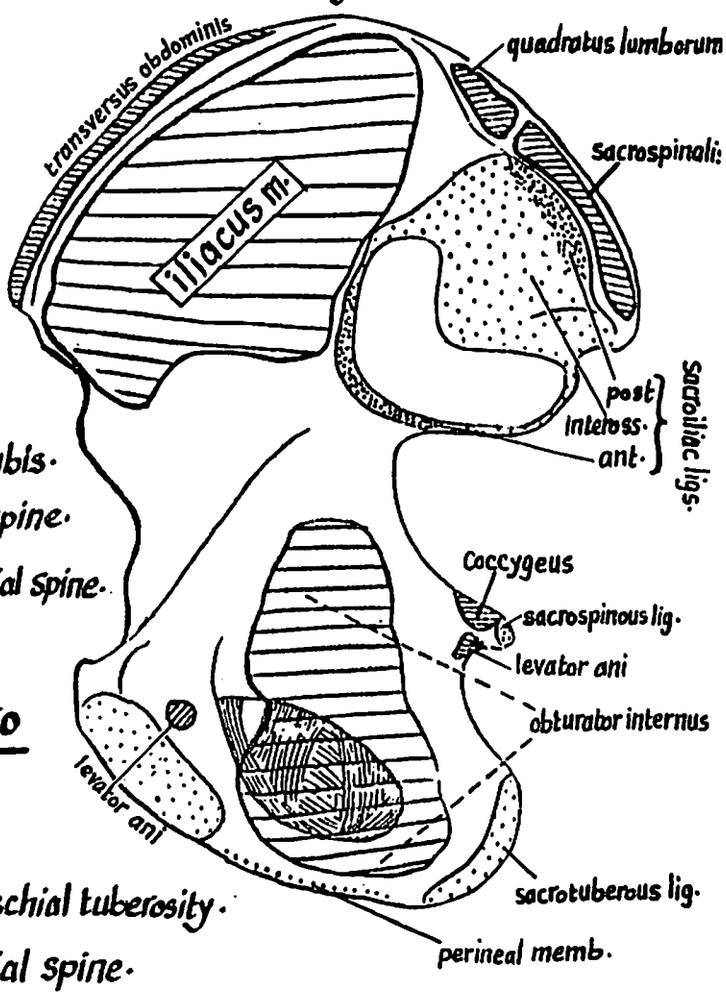
VII- Muscles of med. aspect of hip bone:

(1) iliacus m.: arises from upper 2/3 of iliac fossa.

(2) obturator internus m.: arises from the margins of the obturator foramen & pelvic surfaces of ilium & ischium.

(3) levator ani m.:
- ant. fibres: arise from the back of body of pubis.
- post. fibres: arise from inner aspect of ischial spine.

(4) Coccygeus m.: arises from inner aspect of ischial spine.



* Ligaments & membranes attached to the hip bone

(1) Sacrotuberous lig.: attached to med. border of ischial tuberosity.

(2) sacrospinous lig.: " " the tip of ischial spine.

(3) interosseous sacro-iliac lig.: attached to the iliac tuberosity (behind the auricular surface).

(4) ant. sacroiliac lig: attached to the preauricular sulcus (infront of the auricular surface).

(5) post. sacroiliac lig.: " " " ilium behind the iliac tuberosity.

(6) inguinal lig. attached between: the A.S.I.S (laterally) & pubic tubercle (medially).

(7) lacunar lig. & pectineal lig.: attached to pectineal line of the sup. pubic ramus

(8) obturator membrane: attached to the margins of the obturator foramen (except its ant. part).

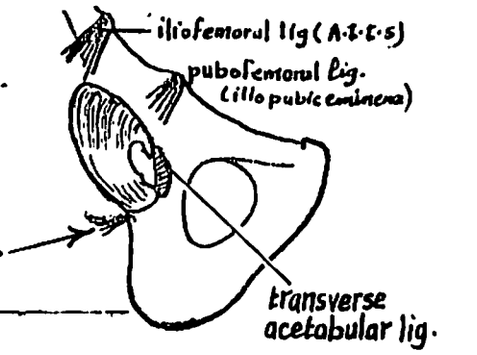
(9) perineal " : attached to the 2 ischiopubic rami.

(10) transverse acetabular lig.: " " " margins of acetabular notch.

(11) iliofemoral lig.: attached to the ant. Inf. iliac spine.

(12) pubofemoral lig.: " " " iliopubic eminence.

(13) ischiofemoral lig.: " to a groove below the acetabulum.



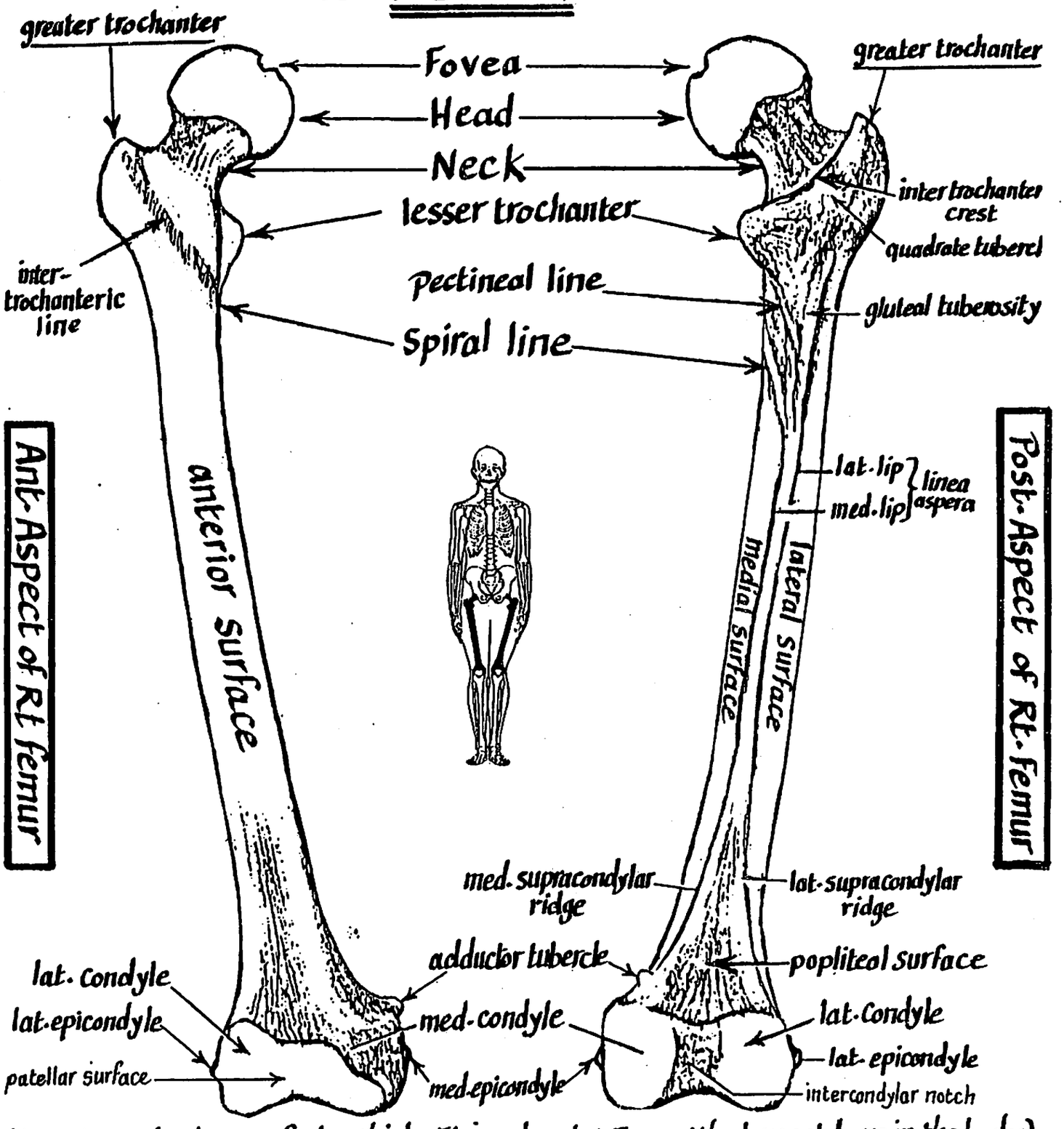
Articulations of the hip bone

(1) the auricular surface of ilium articulates with the sacrum by plane synovial joint (sacroiliac joint)

(2) the acetabulum articulates with the head of femur by ball & socket synovial joint (hip joint).

(3) the symphyseal surface of pubis articulates with its fellow of the opposite side by 2ry cartilagenous joint (symphysis pubis).

2- Femur



Site: it is the bone of the thigh. It is about 45 cm (the longest bone in the body)

General features: it is a typical long bone formed of — upper end, shaft, lower end

Articulations:

(1) the head: articulates with the acetabulum in the hip joint.

(2) the 2 femoral condyles articulate with the 2 tibial condyles } knee joint

(3) the patellar surface of lower end articulates with the post. surface of patella } knee joint

Subcutaneous parts:

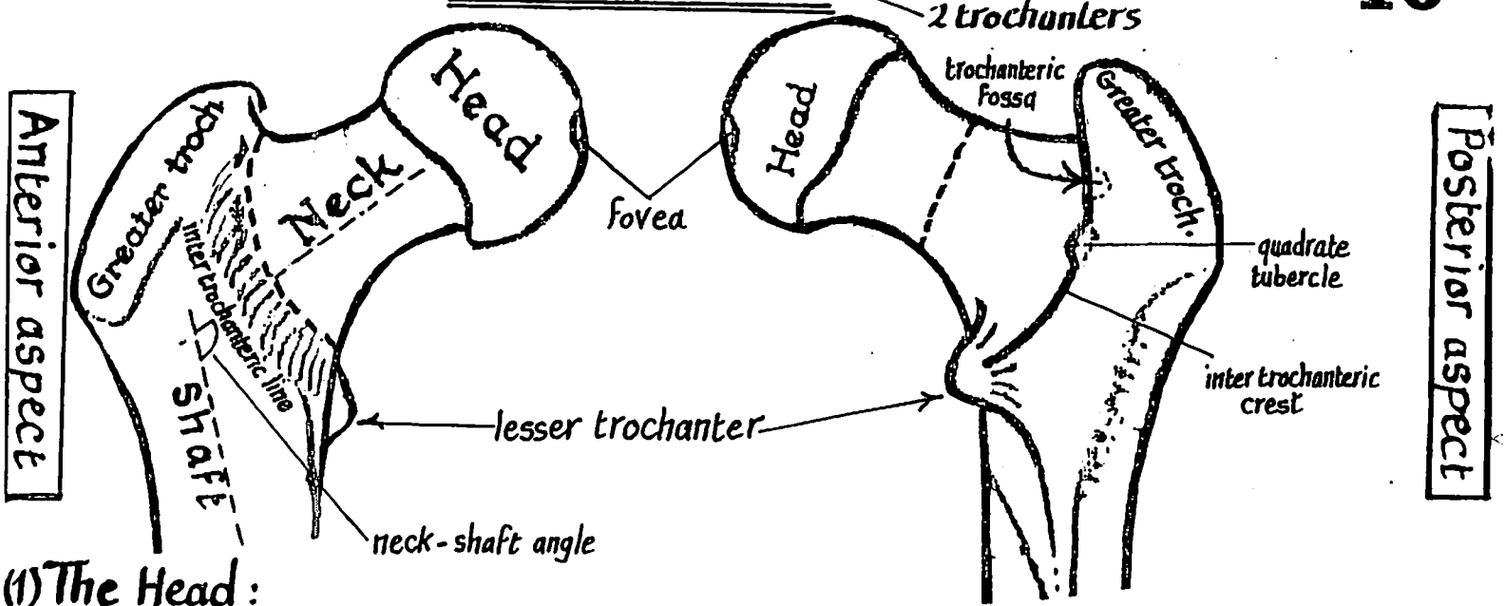
(1) the greater trochanter

(2) the 2 condyles & epicondyles

(3) the adductor tubercle

The upper end

head
neck
2 trochanters



(1) The Head:

- forms more than ½ a sphere & is directed upwards, forwards & medially.
- near its centre, there is a depression called **pit or fovea** (gives attachment to round lig.).
- In the living, the head is covered by hyaline cartilage (except the fovea) & articulates with the acetabulum (hip joint).

(2) The Neck:

- it is about 5 cm long & connects the head with the shaft.
- it forms an angle of 110- 120° with the axis of the shaft called the **Neck-Shaft angle**
- the significance of this angle is to allow free movement of femur away from the pelvis. The angle is smaller in females due to the large size of the pelvis

(3) Greater trochanter:

- a quadrangular eminence which projects laterally & upwards at the junction of the neck & shaft
- its lat. surface carries an oblique ridge
- its med. surface carries a depression called trochanteric fossa.

(4) Lesser trochanter:

a small pyramidal projection which lies posteromedially at the junction of the neck with the shaft

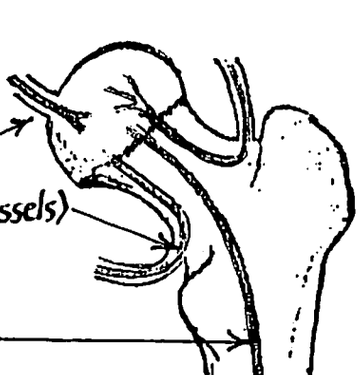
(5) Intertrochanteric line:

a rough line joining the greater & lesser trochanters anteriorly.

(6) Intertrochanteric crest:

- a rounded ridge connecting the greater & lesser trochanters posteriorly.
- the intertrochanteric crest shows a prominence called **quadrate tubercle** above its middle.

Blood Supply of the head of femur



(1) From a small artery in the ligamentum teres (attached to the fovea)

(2) From the blood vessels in the capsule of the hip joint (retinacular vessels) which reflect to the neck (main supply).

(3) From ascending branch of the nutrient a. in the shaft.

The Shaft of Femur

* It is convex forwards (to throw the line of the body weight infront of the knee joint thus keeping it passively extended).
* Its middle ⅓ has 3 surfaces while its upper & lower thirds have 4 surfaces.

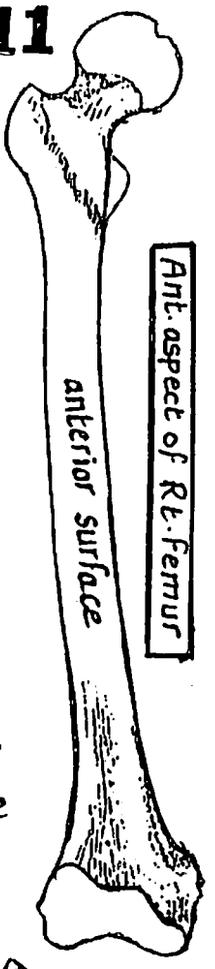
A- Middle ⅓ of the Shaft :

* It has 3 borders : post. border (linea aspera), med. border : rounded, lat. border : ,,
* It has 3 surfaces : ant. surface, med. ,, , lat. ,,

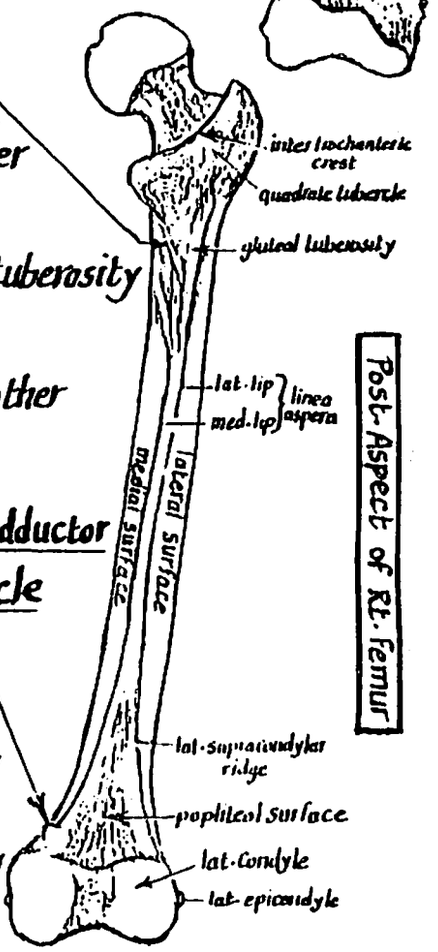
- **Linea aspera** (post. border):
 - it is a broad thick ridge forming the post. border of the middle ⅓ of the shaft.
 - it has 2 lips (lateral & medial) which lie close in the middle ⅓ but diverge from each other in the upper ⅓ & the lower ⅓ of the shaft.

(a) **in the upper ⅓ :**
- the med. lip of linea aspera extends up forming the **spiral line** which winds around the med. aspect of the shaft below the lesser trochanter to reach the lower end of the intertrochanteric line.
- the lat. lip of linea aspera is continuous above with the gluteal tuberosity

(b) **in the lower ⅓ :**
- the med. & lat. lips of the linea aspera diverge from each other forming the med. & lat. supracondylar lines
- the med. supracondylar line ends below in a tubercle called the **adductor tubercle**



Ant. aspect of Rt. femur



Post. Aspect of Rt. femur

B- the upper ⅓ of the Shaft

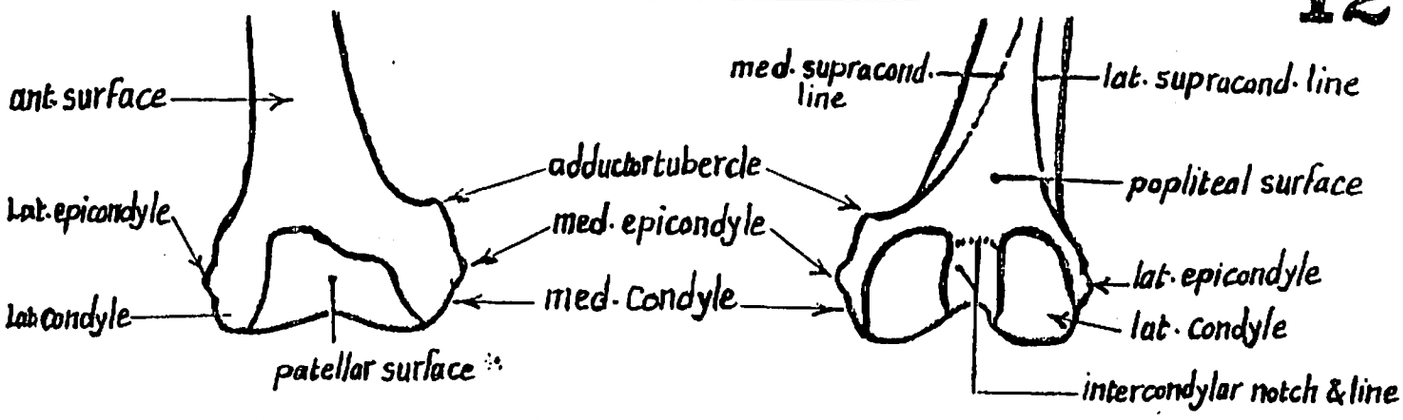
* It is flattened posteriorly, having a post. surface in addition to the ant., lat. & med. surfaces.
* the post. surface is bounded laterally by gluteal tuberosity, medially by the spiral line

* **The pectineal line of femur** : is a rough line on the post. surface of the upper ⅓ of the shaft, extending from the lesser trochanter to the upper end of linea aspera

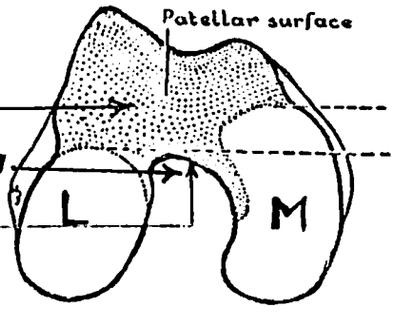
C- the lower ⅓ of the Shaft

* has also a post. surface called the **Popliteal Surface** which is bounded by the medial & lateral supracondylar lines

Lower end of femur

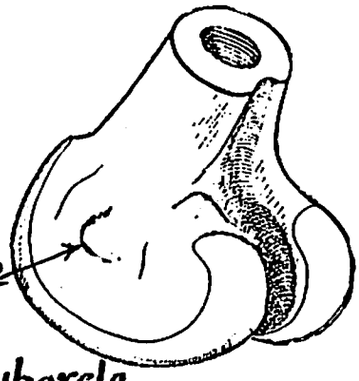


*It is composed of 2 large condyles : medial & lateral
* anteriorly, the 2 condyles fuse together forming an articular surface for the patella called the **patellar surface**
* posteriorly, the 2 condyles are separated by **intercondylar notch** the notch is separated from the popliteal surface by intercondylar line.



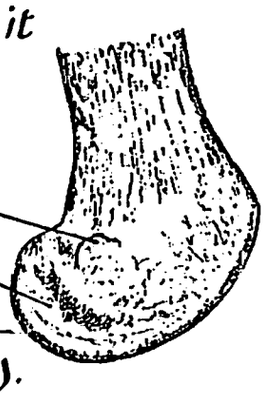
(A) The medial condyle :

(1) it is larger & more curved than the lateral condyle as it is concerned mainly with the rotatory movements of the knee joint
(2) it projects more downwards (to compensate for the obliquity of the shaft
(3) the most prominent part of its med. surface is called **med. epicondyle** the upper part of the med. condyle (at the lower end of the med. supracondylar line) carries a projection called the **adductor tubercle**



(B) The lateral condyle :

(1) is smaller, thicker, stronger & less curved than the med. condyle as it is concerned mainly with body weight transmission
(2) it projects more forwards (to prevent lat. dislocation of the patella)
(3) the most prominent part of its lat. surface is called **lat. epicondyle**.
(4) below the lat. epicondyle, there is a groove called popliteal sulcus.

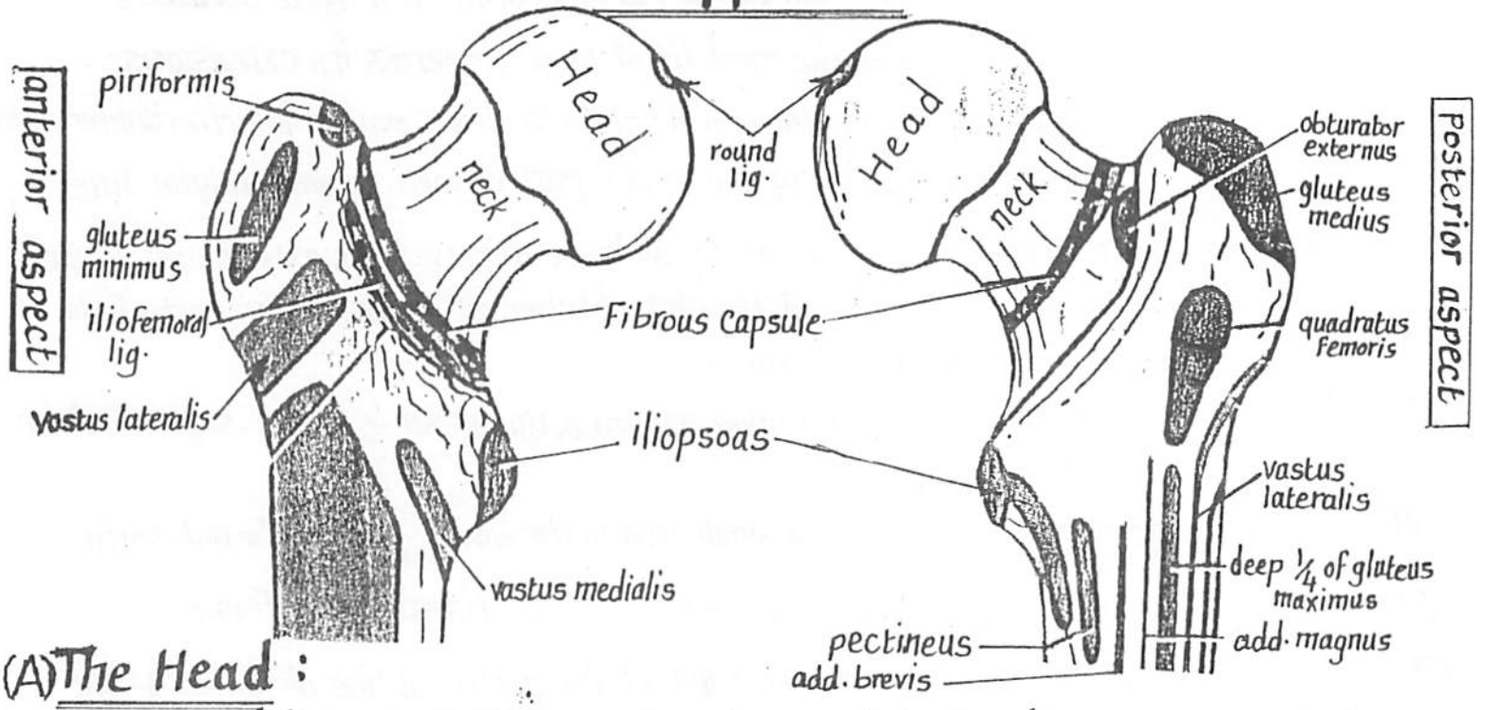


Identification of the side of femur (Rt. or Lt).

(1) the upper end is identified by the head.
(2) the head is directed medially.
(3) the shaft is convex forwards.

Muscles & Ligaments attached to the femur

I- The upper end



(A) **The Head** :

the round ligament (ligamentum teres) of the head is attached to the fovea.

N.B: it has no mechanical importance. Its main function is to carry blood supply to the head of femur.

(B)- **The greater trochanter** : gives insertion to 5 musules :

(1) piriformis : inserted into its upper border (top).
(2) Gluteus minimus : " " " anterior surface.
(3) Gluteus medius : " " the oblique ridge on its lat. surface.
(4) obturator internus (& the 2 gemilli) : inserted into its med. surface.
(5) Obturator externus : inserted into the trochanteric fossa on the med. surface.

(C)- **The lesser trochanter** : gives insertion to the iliopsoas tendon.

(D)- **Inter trochanteric line** : gives attachment to :
(1) fibrous capsule of the hip joint.
(2) iliofemoral ligament.
(3) origin of sup. part of vastus medialis (from its lower end).
(4) " " " " vastus lateralis (" " upper end).

(E) **Quadrate tubercle** & the bone below it : gives insertion to quadratus femoris m.

(F) **Gluteal tuberosity** :
- gives insertion to the deep 1/4 of gluteus maximus.
- its med. border : insertion of pubic part of add. magnus m.
- its lat. border : origin of vastus lateralis.

(G) **Back of neck of femur** : gives attachent to the capsule of hip joint 1 cm. proximal to the intertrochanteric crest.

Muscles attached to the Shaft of Femur

(1) **Vastus intermedius**: arises from the upper 3/4 of the ant. & lat. surfaces

(2) **Vastus medialis**: arises from the med. lip of linea aspera & its extensions:
- (a) upwards along the spiral line to the lower part of intertrochanteric line.
- (b) downwards along the upper part of med. supracondylar line.

(3) **Vastus lateralis**: arises from the lat. lip of linea aspera & its extensions upwards along the lat. lip of the gluteal tuberosity to the upper part of the intertrochanteric line.

(4) **Short head of biceps**: arises from linea aspera & the upper ½ of lat. supracondylar ridge.

(5) **Articularis genu m.**: arises from a small area in the lower part of the ant. surface.

(6) **Pectineus m.**: inserted into the upper part of the pectineal line of femur.

(7) **Adductor brevis**: " " " lower part of the pectineal line of femur + the upper part of the linea aspera.

(8) **Adductor longus**: inserted into the linea aspera.

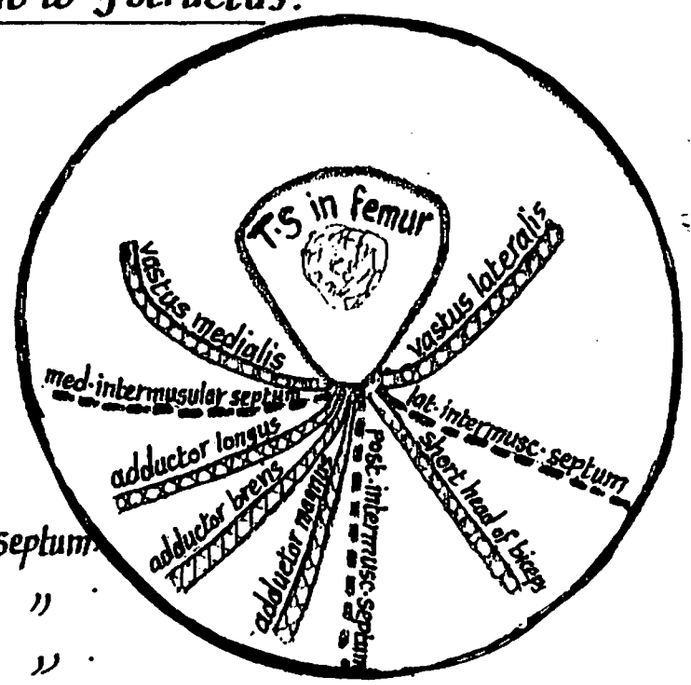
(9) **Adductor magnus**:
- (a) *pubic part*: inserted into the med. border of the gluteal tuberosity, med. lip of linea aspera & med. supracondylar ridge.
- (b) *ischial part*: inserted into the adductor tubercle.

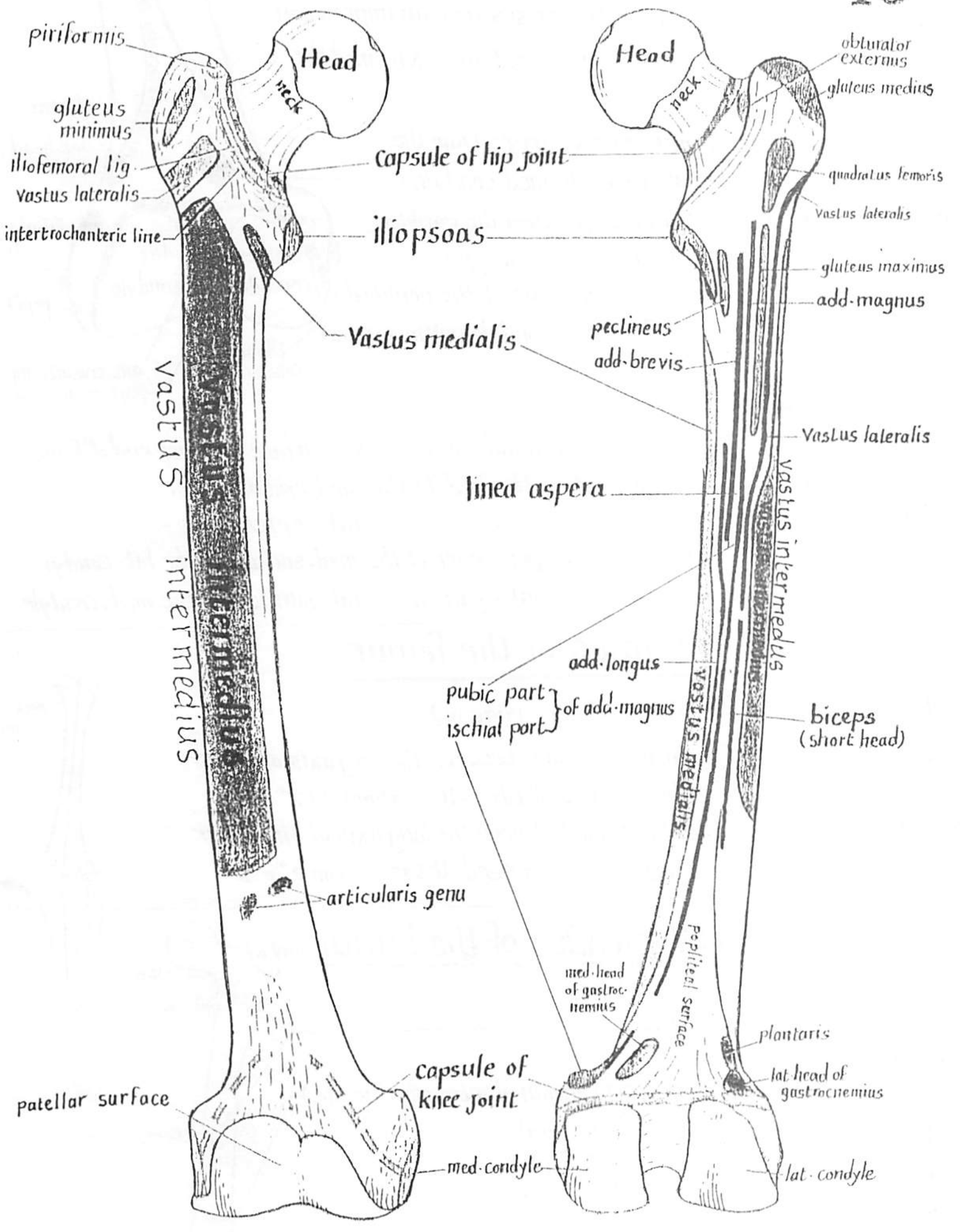
N.B: the linea aspera gives attachment to 9 structus:

3 Insertions
- adductor brevis.
- adductor longus.
- adductor magnus.

3 Origins
- vastus medialis.
- vastus lateralis.
- short head of biceps.

3 Intermuscular Septa:
- med. intermusc. septum
- lat. " " "
- post. " " "





Ant. aspect of Rt. femur

post aspect of Rt. femur

Muscles & Ligaments attached to the lower end of femur 16

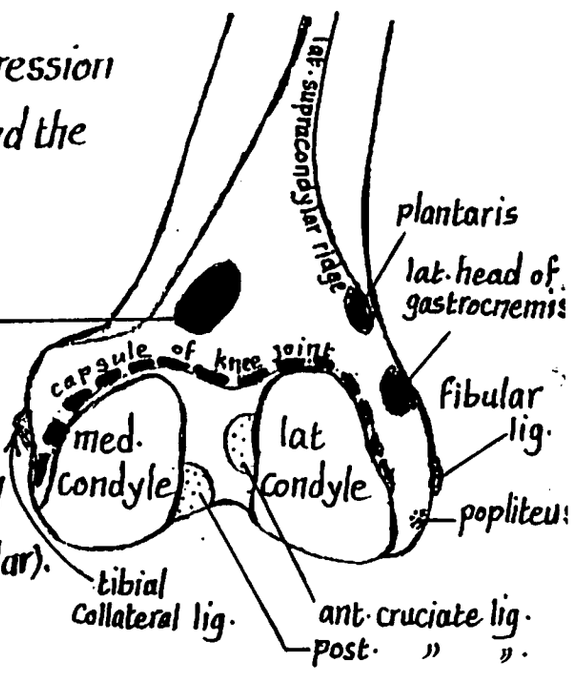
(I) Muscles :

(1) **Lat. head of gastrocnemius** : arises from an impression on the lat. surface of the lat. condyle (just above & behind the lat. epicondyle.

(2) **Med. head of gastrocnemius** : arises from the popliteal surface of femur above the med. condyle.

(3) **Plantaris** (if present) : arises from the popliteal surface above the lat. condyle.

(4) **Popliteus** : arises from the ant. part of the popliteal sulcus below the lat. epicondyle (intracapsular).



(II) Ligaments :

(1) **Capsule** of knee joint : attached around the articular surface of lower end of femur.
(2) **tibial Collateral lig.** of knee joint : attached to the med. epicondyle.
(3) **fibular Collateral lig.** " " " : " " " lat. epicondyle.
(4) **ant. cruciate lig.** : attached to the post. part of the med. surface of the lat. condyle.
(5) **post. " "** : " " " ant. part " " lat. surface of the med. condyle.

Angles of the femur

(1) **Neck Shaft angle** : 110 - 120° (see page 10).

(2) **Angle of inclination** : it is the angle between the long axis of femur & the long axis of tibia. It is about 172°

(3) **Angle of torsion** : it is the angle between the long axis of the upper end & that of the lower end. It varies from 0° to 30°

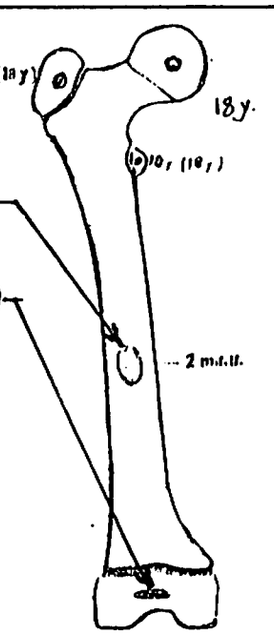


Ossification of the femur

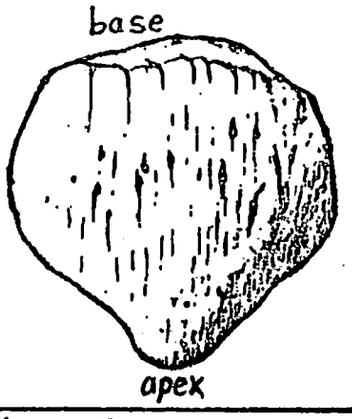
The femur ossifies from 5 centres :

* One primary centre for shaft.
* 4 Secondary centres in :

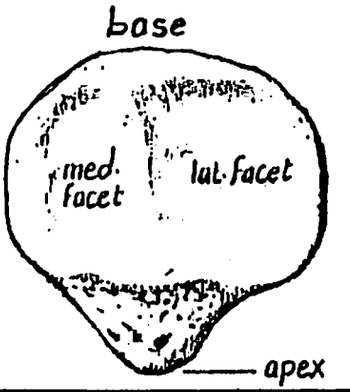
(1) lower end (appears during the 9th month of intra-uterine life)
(2) greater trochanter (appears after birth).
(3) lesser " (" " ").
(4) the head (" " ").



Patella

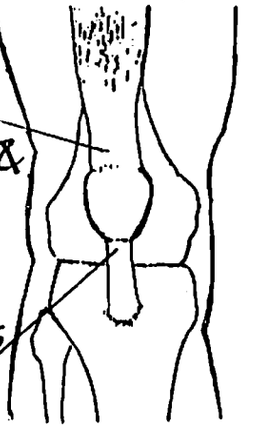


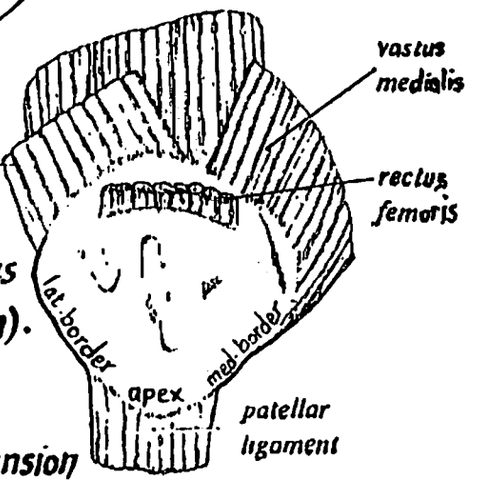
Ant. surface of Rt. patella



post. surface of Rt. patella

* The patella is the **largest sesamoid bone** in the body.
* **position**: it lies infront of knee, inside the quadriceps tendon.
* **Shape**: triangular in shape having base above, apex below, ant. & post. surfaces, med. & lat. borders.
* **The Base** (upper border):
 gives attachment to the tendon of insertion of quadriceps (mainly rectus femoris & vastus intermedius).
* **The Apex**: is directed downwards & gives attachment to the patellar ligament.
* **The Lateral border**: gives attachment to the lower fibres of vastus lateralis (lat. vastal retinaculum).
* **The Medial border**: gives attachment to the lower fibres of vastus medialis (med. vastal retinaculum).
* **The Anterior surface**: is rough & subcutaneous:
 In the living, it is covered by an expansion from quadriceps tendon & separated from the skin by a bursa.



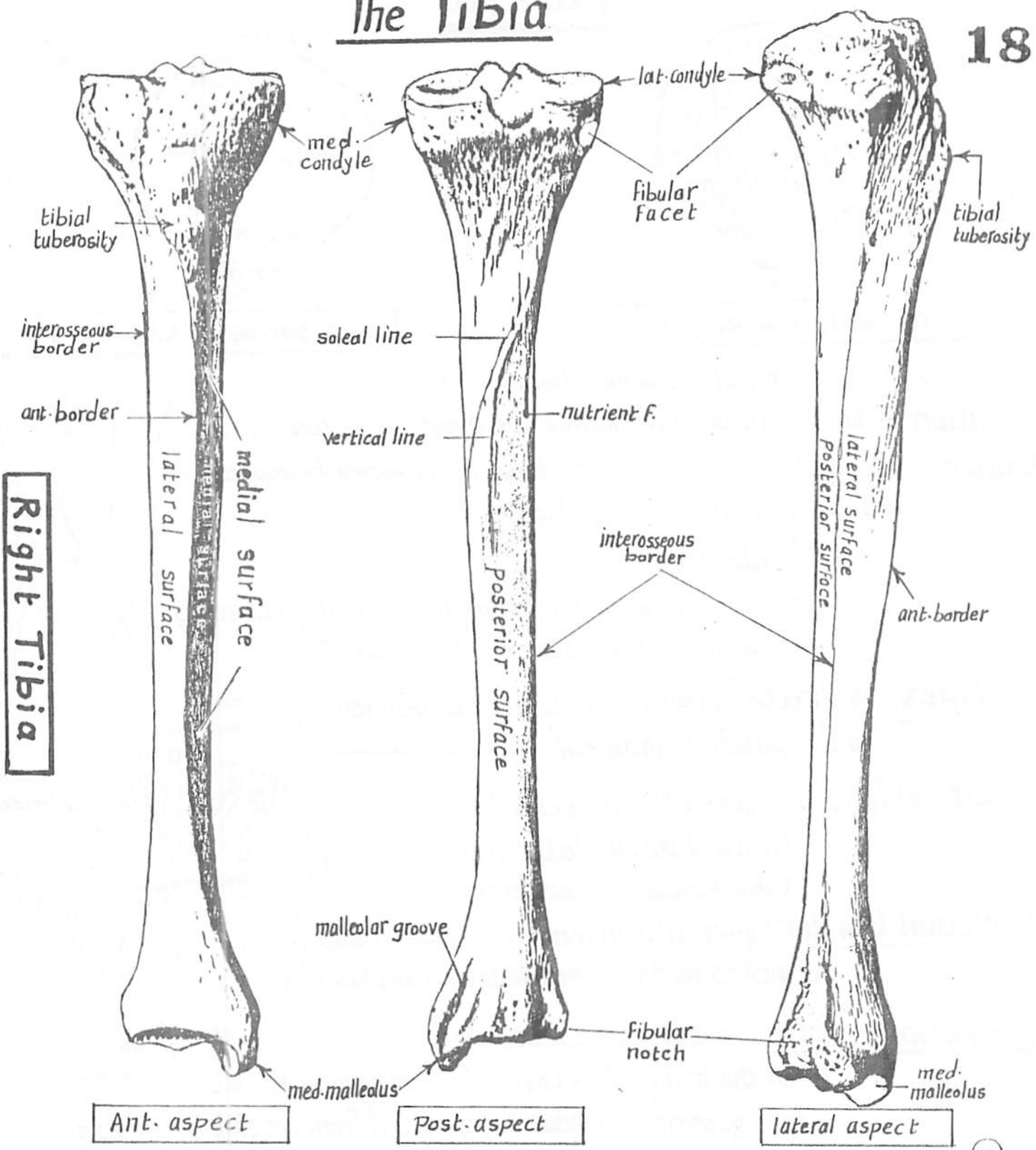


* **The Posterior surface**:
 - its lower 1/3 is rough & non articular.
 - its upper 2/3 is smooth & divided by a longitudinal ridge into 2 articular facets:
 (1) a large lat. facet for articulation with the lat. condyle of femur.
 (2) a small med. " " " " " med. " " " .

* **Identification of the Side of the patella (Rt. or Lt.)**:

(1) the base is directed upwards & the apex downwards.
(2) the ant. surface is rough, the post. surface is smooth showing 2 articular facets.
(3) the lat. articular facet is larger than the med. one.

The Tibia





* **Type**: typical long bone * **site**: it is the med. bone of the leg.

* **Functions**:

(1) Tibia alone receives the weight from femur & transmits it to the foot.

(2) gives attachments to muscles.

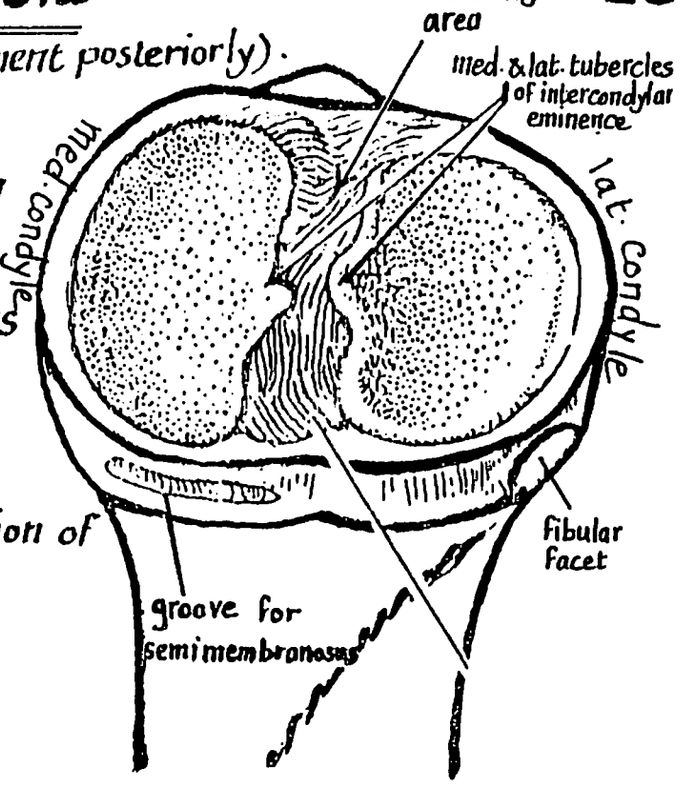
* **Identification of the side (Rt. or Lt.)**:

(1) the upper end is large & carries 2 condyles while the lower end is smaller & presents med. malleolus.

(2) the tibial tuberosity is directed forwards (3) the med. malleolus lies medially.

* **Structure**: it is composed of upper end, shaft & lower end.

I- upper end of tibia



(A) The medial Condyle: (larger & more prominent posteriorly).

* **Its upper surface:**
 - Carries an oval facet for articulation with the med. condyle of femur.
 - The periphery of the articular surface shows the print of the medial meniscus.

* **Its posterior aspect:**
 presents a horizontal groove for the insertion of semimembranosus m.

(B) The lateral Condyle: (smaller)

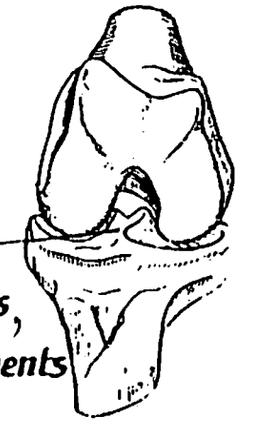
* **Its upper surface:**
 Carries a circular facet for articulation with the lat. condyle of femur.
 the periphery of the articular surface shows the print of the lat. meniscus.

* **Its posterolateral surface:**
 - presents a circular fibular facet for articulation with the head of fibula.

(C) InterCondylar area:

- intercondylar eminence.
- ant. intercondylar area.
- post. intercondylar area.

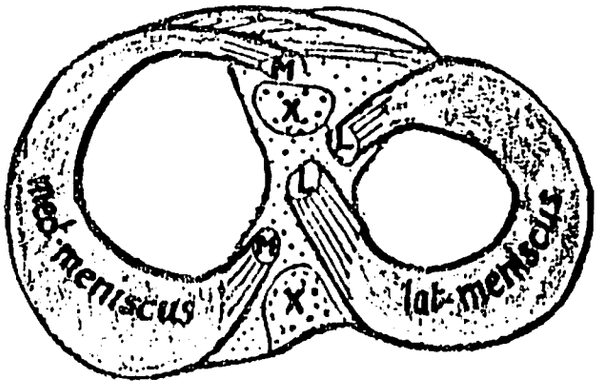
(between the upper surfaces of the 2 condyles)



* in its middle part there is an elevation called intercondylar eminence

Function: the intercondylar eminence of tibia which has med. & lat. tubercles, projects into the intercondylar notch of femur preventing side to side movements of femur on tibia.

* **Anterior intercondylar area:** gives attachment to the following structures (arranged from before backwards):
 (a) ant. horn of med. meniscus (M)
 (b) ant. cruciate ligament (X)
 (c) ant. horn of lat. meniscus (L)



* **Post-intercondylar area:** gives attachment to:
 (a) post. horn of lat. meniscus (L)
 (b) " " " med. " (M)
 (c) " cruciate ligament (X)

(D) Tibial tuberosity : it is divided into :

(1) upper smooth part : gives attachment to the patellar ligament

(b) lower rough part : is related to bursa (infrapatellar bursa

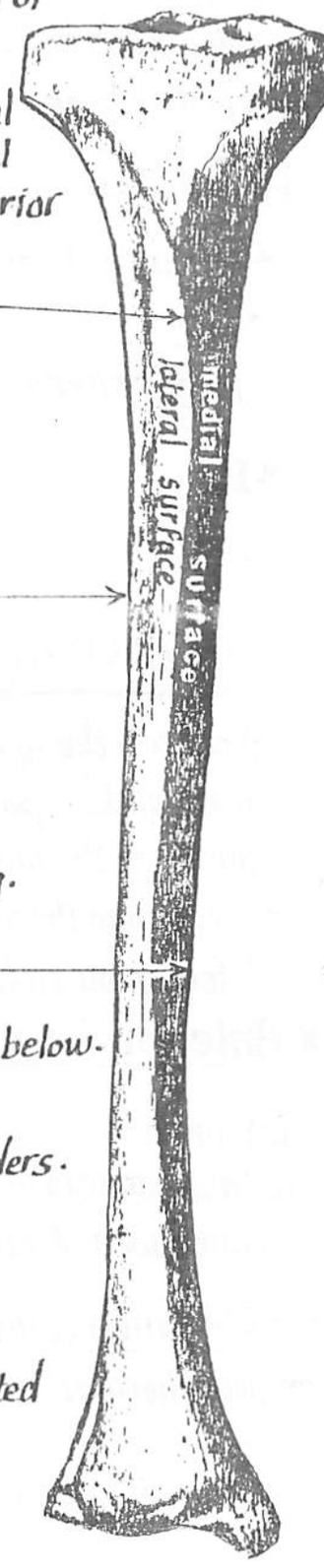
N.B : the line between the smooth & rough part indicates the position of the epiphyseal cartilage i.e the site of union between the epiphysis & the shaft.



II- The Shaft of tibia

* it is very thick above & becomes gradually thinner till the junction of the middle & lower thirds then becomes thick again at the lower end.

*It has 3 borders < anterior, interosseous, medial & 3 surfaces : medial, lateral, posterior



(1) The anterior border (Shin of tibia) :
begins above at the tibial tuberosity
its upper 3/4 is sharp & felt subcutaneously
its lower 1/4 is rounded & ends below at the med. malleolus.
the ant. border gives attachment to the deep fascia of the leg.

(2) The Interosseous border :
- begins above at the fibular facet
- ends below at the ant. border of the fibular notch.
- it gives attachment to the interosseous membrane except :
(a) at its upper end : where a gap is present for ant. tibial vessels
(b) " " lower end : where it gives attachment to ant. tibiofibular lig.

(3) The Medial border :
- begins below the med. condyle above & ends at the med. malleolus below.
- it is distinct only in its middle 1/3.

(4) The lateral surface : lies between the ant. & interosseous borders.

(5) The medial Surface :
- lies between the ant. & med. borders
- it is subcutaneous except its upper most part to which is inserted 3 muscles (S-G-S).

(6) The Posterior Surface:

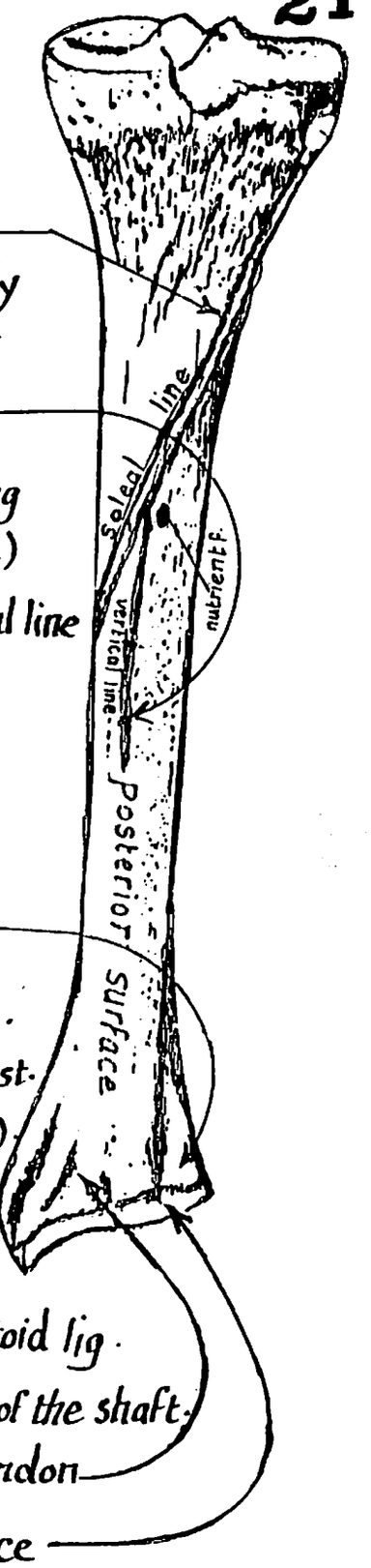
- lies between the interosseous & medial borders
- it presents 2 lines & nutrient foramen:

(a) the **Soleal line**: extends from the fibular facet obliquely downwards & medially to the junction between the upper 1/3 & middle 1/3 of the med. border

(b) the **Vertical line**: extends from the middle of the soleal line downwards dividing the post. surface below the soleal line into 2 parts (med. & lat.)

(c) **Nutrient foramen**: is present at the upper end of the vertical line

N.B: it is the largest nutrient foramen in the body.



The Lower end of tibia

* It is thick & has 5 surfaces:

(1) **lateral surface**: has fibular notch for the lower end of fibula
- the floor of the notch gives attachment to interosseous tibiofib. lig.
- to the ant. & post. borders of the notch is attached the ant. & post. tibiofibular ligaments of the inf. tibiofibular joint (fibrous joint)

(2) **Med. surface**: projects down forming the **med. malleolus** which has a groove on its back for 2 muscles < tibialis post, flex. digit. longus
- the lower border of the med. malleolus gives attachment to the deltoid lig.

3) **Ant. surface**: is smooth & continuous above with the lat. surface of the shaft.

(4) **post. surface**: has a faint groove for flexor hallucis longus tendon

5) **Inferior surface**: shows a concave 4-sided articular surface which, together with the lat. aspect of the med. malleolus, articulates with the upper surface of talus (ankle joint).

Subcutaneous parts of tibia

(a) the med. & lat. condyles (b) tibial tuberosity (c) shin & med. surface (d) med. malleolus.

Ossification of tibia

(1) A primary centre for the shaft (2) a secondary centre for the upper end (3) secondary centre for the lower end

I- The upper end:

(1) Structures attached to the anterior & post. intercondylar areas: See page 19

(2) Iliotibial tract: attached to the lat. surface of the lat. condyle

(3) Patellar lig.: attached to the tibial tuberosity.

(4) Semimembranosus: inserted into groove on the back of the med. condyle

(5) Capsule of the knee joint: attached around the articular surfaces of both condyles

II- The Shaft:

(A) Medial Surface:

its upper part gives attachment to the following (arranged from before backwards):

(1) Insertion of Sartorius muscle (S)

(2) " " Gracilis muscle (G)

(3) " of Semitendinosus muscle (S)

(4) med. ligament of the knee joint (L)

(B) Lateral Surface:

Tibialis ant. muscle arises from its upper 2/3.

(C) Posterior Surface:

(1) Popliteus m.: inserted into the upper part of the post. surface (above the soleal line).

(2) Soleus m.: arises from the soleal line & the middle 1/3 of the med. border

(3) Flexor digitorum longus: arises below the soleal line & med. to the vertical line

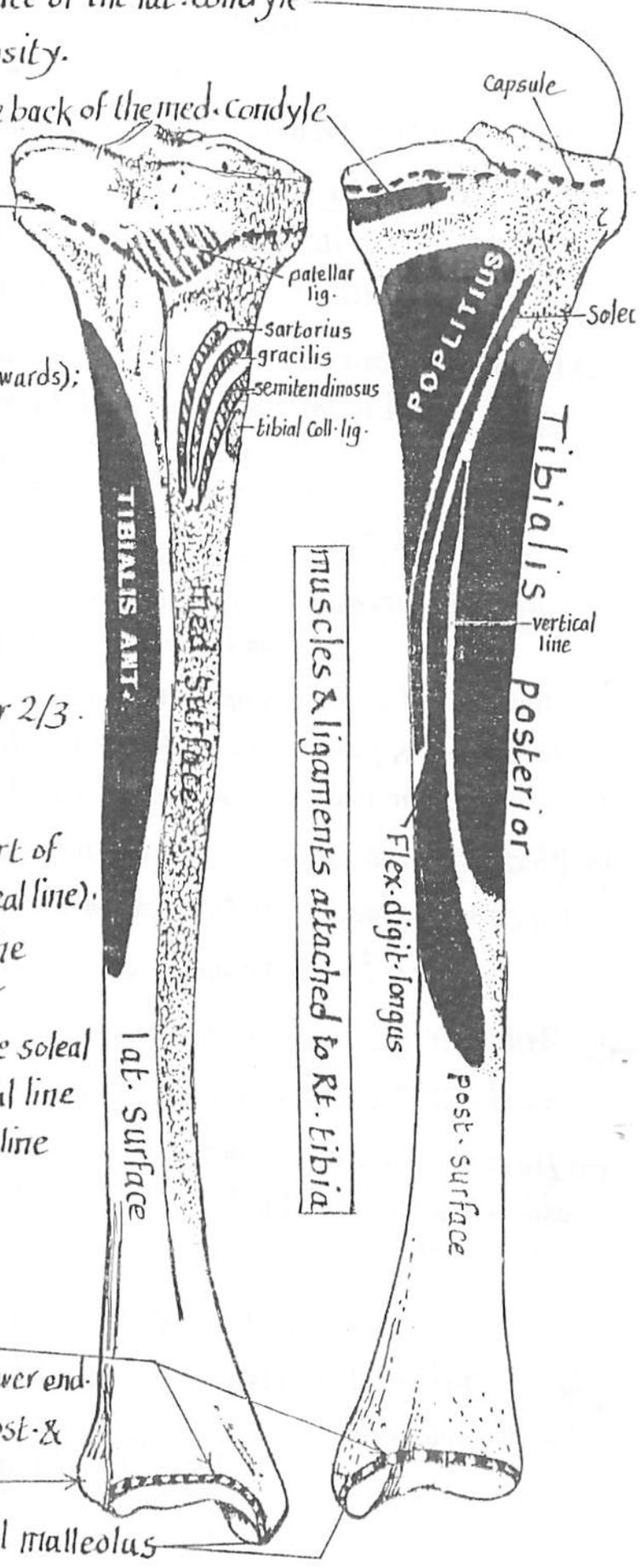
(4) Tibialis posterior: arises below the soleal line & lat. to the vertical line.

The Lower end of tibia:

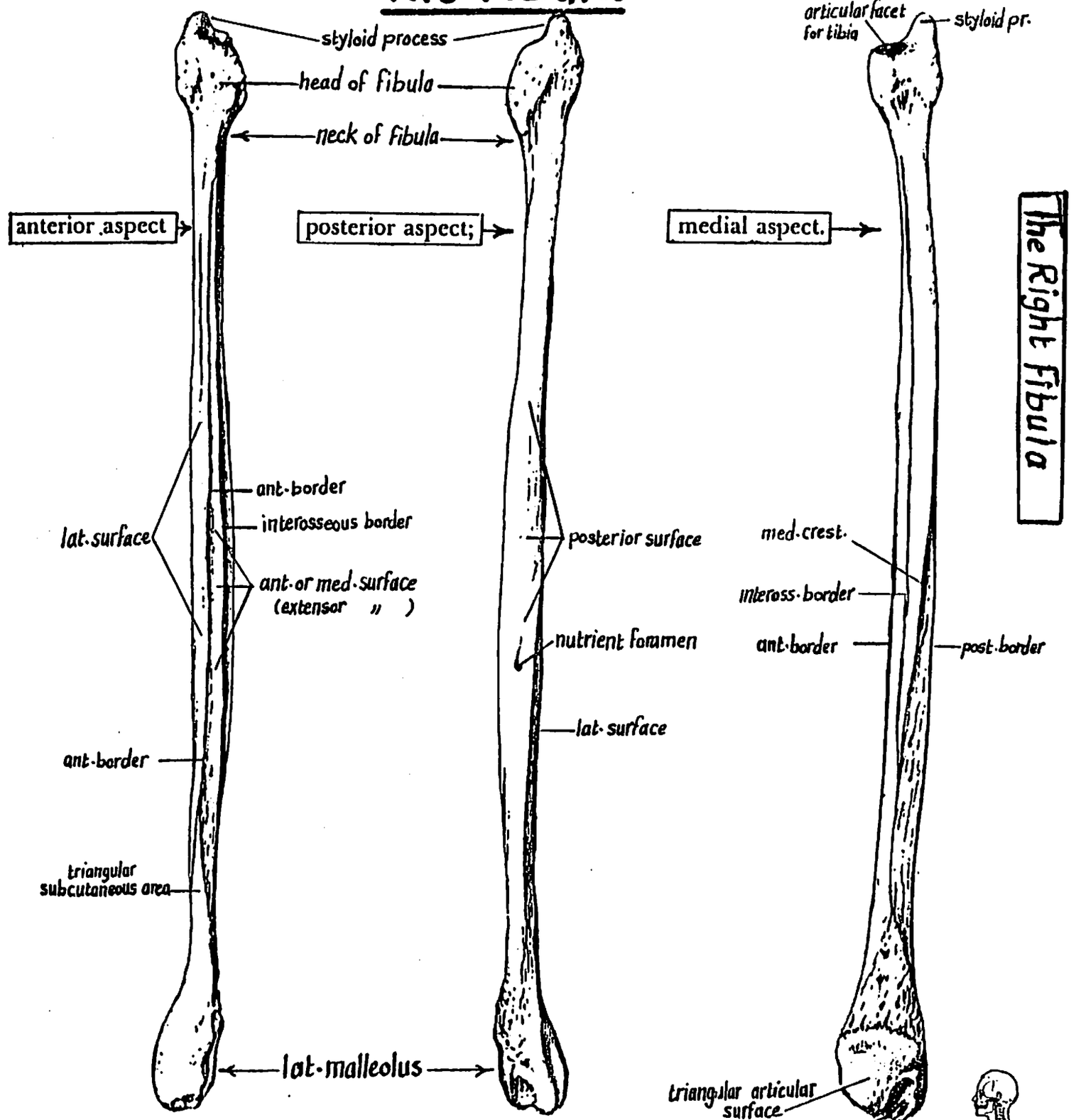
(1) Capsule of the ankle joint: attached around the articular surface of the lower end.

(2) ligaments of inf. tibiofibular joint (ant., post. & interosseous): attached to the fibular notch

(3) Deltoid lig.: attached to the tip of the medial malleolus



The Fibula



The Right Fibula



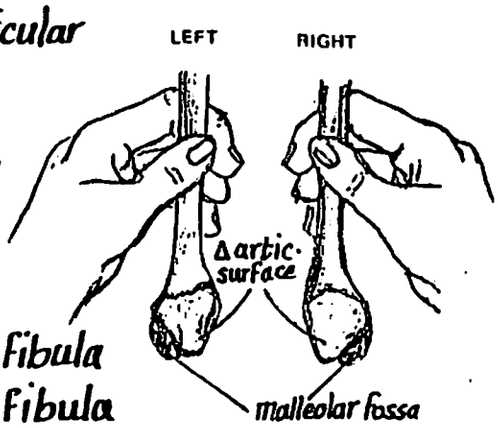
* **Type**: it is a very thin long bone.
* **Site**: it is the lateral bone of the leg.
* **Functions**: (1) gives origin to many muscles of the leg (8).
 (2) forms part of the ankle joint
 (3) its lower end forms a pully for tendons of peroneal muscles

N.B: the fibula does not share in transmission of body weight because it does not articulate with the femur.

Ossification: - one 1ry centre for the shaft
- two 2ry centres for the 2 ends

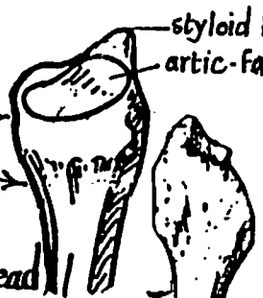
* How to know the side of the fibula (Right or Left) ?

(1) the upper end is bulky & formed of head & styloid process.
(2) the lower end is compressed from side to side.
(3) the med. side of the lower end presents triangular articular surface & a depression called malleolar fossa.
(4) the Δ articular surface lies ant. to the malleolar fossa.



NB: A simple method to identify the side of the fibula is to look to the med. side of the lower end :
- if the malleolar fossa lies to the Rt. ⟶ it is the Rt. fibula
- " " " " " " Lt. ⟶ it is the Lt. fibula

General features of the fibula



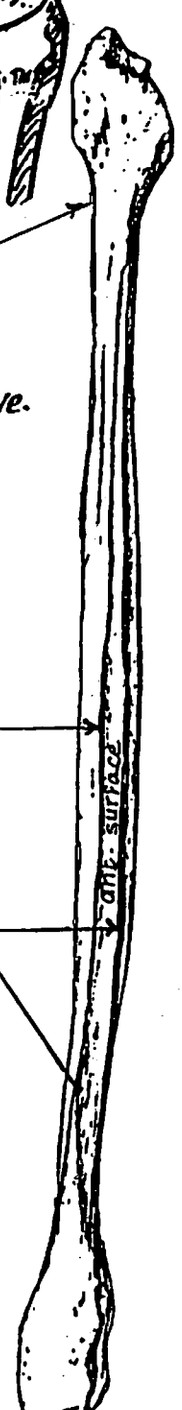
1- The upper end < head, neck

* **The Head** : has 2 features :
(1) Styloid process : projects upwards from the posterolat. aspect of the head.
(2) Articular facet : for articulation with the lateral condyle of tibia.

* **The Neck** : it is the constriction just below the head.
- it is related laterally to the lat. popliteal (common peroneal) nerve.

II- The Shaft

has 3 borders < anterior, interosseous, posterior & 3 surfaces < ant. (med.), lat., post.



(1) **Anterior border** :
begins below from the apex of the triangular subcutaneous area on the lat. surface of the lower end of fibula.

(2) **Interosseous border** :
lies close to the ant. border & may fuse with it in the upper part of the shaft.

(3) **Posterior border** :
extends from the back of the lat. malleolus to the back of the head.

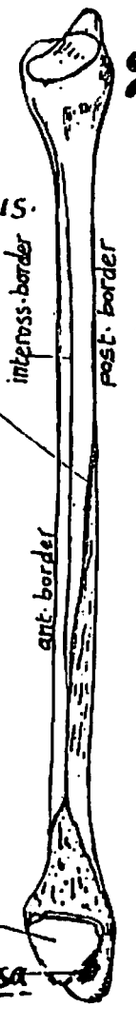
(4) **Anterior Surface** : (Sometimes called medial or extensor surface) :
- lies between the ant. & interosseous borders.
- it is a very narrow surface especially in the upper part where it forms a line.

(5) **Lateral (peroneal) surface :**

- lies between the ant. & post. borders & is a wide surface
- its lower ¼ faces backwards & is continuous with the back of lat. malleolus.

(6) **Posterior surface** (Flexor surface) :

- lies between the interosseous & post. borders .
- it is divided into ant. & post. parts by a ridge called the **medial crest**



Lower end of fibula

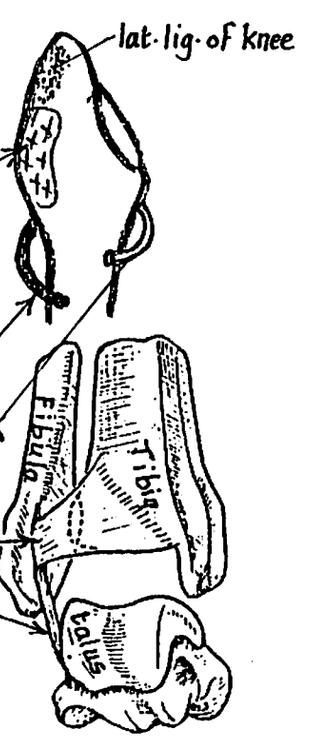
- it is called the lateral malleolus.
- it projects downwards more than the med. malleolus of tibia.
- its ant. surface : is rough (gives attachment to ant. tibiofibular lig.).
- its post. surface : presents a groove for peroneus longus tendon.
- its lat. surface : forms the lower part of the Δ subcutaneous area.
- its medial surface presents :
 - anteriorly : Δ **articular facet** for articulation with lat. surface of talus
 - posteriorly : a depression below & behind the facet called **malleolar fossa** which gives attachment to 2 ligaments : (1) post. tibiofibular lig.
 (2) » talofibular lig.

* **Subcutaneous parts of fibula** : (1) the head.
(2) the lateral malleolus.

Particular features.

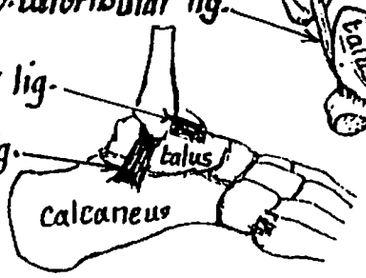
I- upper end :

(1) Biceps muscle : inserted into the lat. aspect of the head
(2) lateral ligament of knee joint : attached to the head of fibula deep to the biceps tendon.
(3) lat. popliteal nerve : curves around the lat. aspect of the neck
(4) Circumflex fibular artery : related to the post. aspect of the neck



II- Lower end :

(A) Medial surface : malleolar fossa → its upper part : post. tibiofibular lig.
its lower » : post. talofibular lig.
(B) Anterior surface : to it is attached the ant. talofibular lig.
(C) Inf. border : gives attachment to the calcaneofibular lig.



II- Muscles attached to the Shaft

(A) Ant. or med. (extensor) surface:

(1) Ext. digitorum longus : arises from the upper 3/4

(2) Ext. hallucis longus : arises from the middle 2/4

(3) peroneus tertius: arises from the lower 1/4

(B) the lateral (peroneal) surface:

(1) peroneus longus m.: arises from its upper 2/3.

(2) peroneus brevis m.: arises from its lower 2/3.

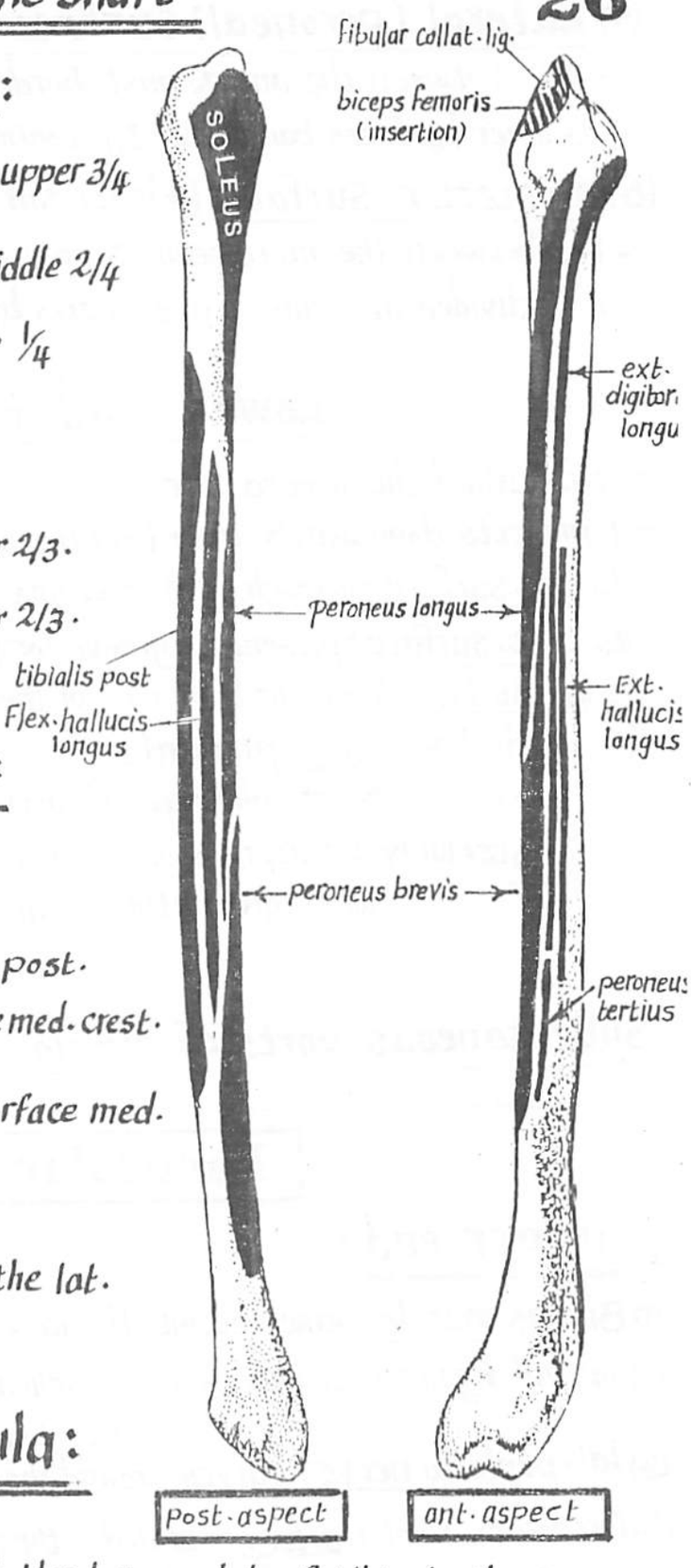
(C) the Posterior (Flexor) Surface:

(1) Soleus m.: arises from its upper 1/3.

(2) Flexor hallucis longus: arises from the post. surface lat. to the med. crest.

(3) Tibialis post.: arises from the post. surface med. to the medial crest.

N.B: Biceps femoris m. is inserted into the lat. aspect of the head of fibula.



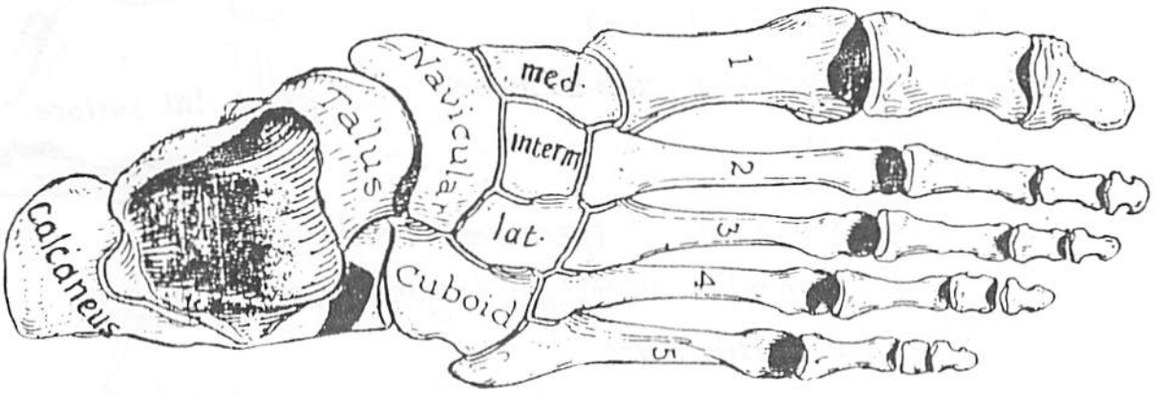
* Articulations of the Fibula:

(1) the head of fibula articulates with the lat. condyle of tibia in the **sup. tibio-fibular joint** (synovial, plane).

(2) the rough area above the med. side of the lower end articulates with the fibular notch of tibia in the **inf. tibiofibular joint** (fibrous joint).

(3) the triangular articular facet on the med. side of the lower end articulates with the lat. side of the talus in the **ankle joint** (hinge synovial joint).

Skeleton of the foot



Tarsus (7 bones)	Metatarsus	Phalanges
عراق Talus كلت Calcaneus كباب Cuboid نفه Navicular ٣ كتاكيت 3 Cuniform bones med. intermed lat.	5 short long bones numbered 1 to 5 from medial to lateral.	-2 for the big toe (proximal & distal). -3 for each of the lat. 4 toes (proximal, middle & distal).

(A) Tarsal bones

(1) Talus:

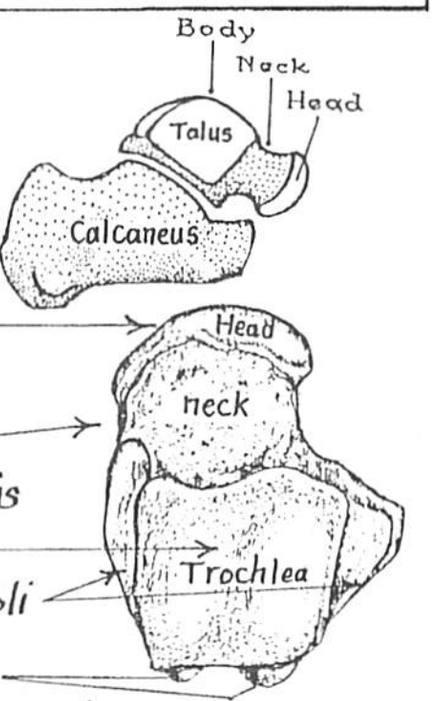
* Site: it is the uppermost tarsal bone, lying above calcaneous
* Structure: it is formed of head, neck & body

(a) the head: it has a hemispherical anterior end for articulation with the navicular bone

(b) neck: it is the constricted part behind the head

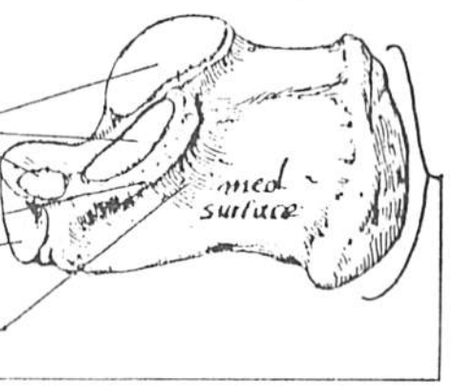
(c) body: -its upper surface articulates with the lower end of tibia & is called the trochlea

- its med. & lat. surfaces articulate with the 2 malleoli
- its post. surface shows 2 tubercles (med. & lat.)
- its inf. surface shows 3 facets (one on the body, one on the neck & one on the head) for articulation with the calcaneus.



(2) Calcaneus (heel bone):

* Site: below talus, it is the most post. tarsal bone.
* its upper surface shows: (a) 3 articular facets for talus
 (b) Sustentaculum tali: a shelf-like process projecting mediolly
* ant. end: having an articular facet for cuboid
* med. surface: showing a groove below the sustentaculum tali
* post. end called the calcanean tuberosity

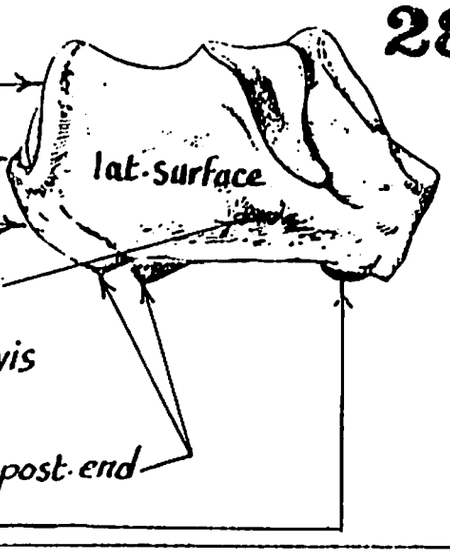


N.B: the post-end of calcaneus has:

(a) upper smooth part (related to bursa)

(b) middle rough part (for insertion of tendo-calcaneus)

(c) lower subcutaneous part



*Its lat. surface shows a small tubercle (peroneal tubercle) which separates the tendons of peroneus longus & brevis

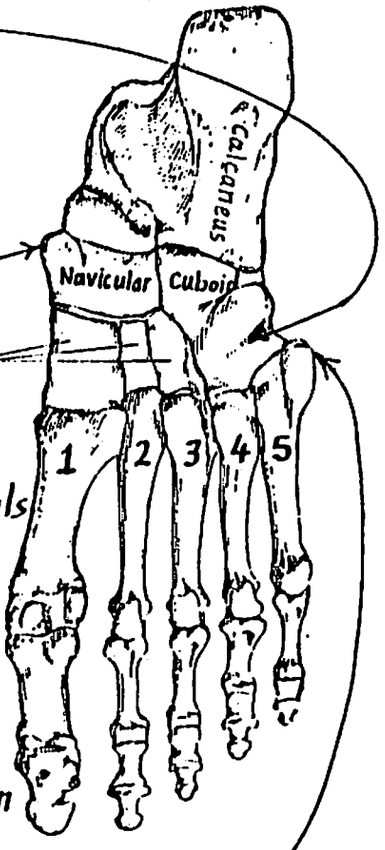
* its plantar surface shows 3 tubercles:
 - med. & lat. calcanean tubercles at the post. end
 - an ant. tubercle at the ant. end.

(3) Cuboid bone:

* it articulates posteriorly with ant. end of calcaneus.
* " " anteriorly with bases of 4th & 5th metatarsal bones.
* its plantar surface shows a groove for peroneus longus tendon.

(4) Navicular bone:

* its post. concave surface articulates with the head of talus
* its ant. convex " " with the 3 cuniform bones
* its med. surface presents tuberosity of navicular bone



(5), (6) & (7): Med., intermediate & lat. cuniform bones

- their post. concave surfaces articulate with the navicular bone
- " ant. convex " " " bases of med. 3 metatarsals

N.B: the med. cuniform is the largest while the intermediate is the smallest & is wedge-shaped.

B - Metatarsal bones

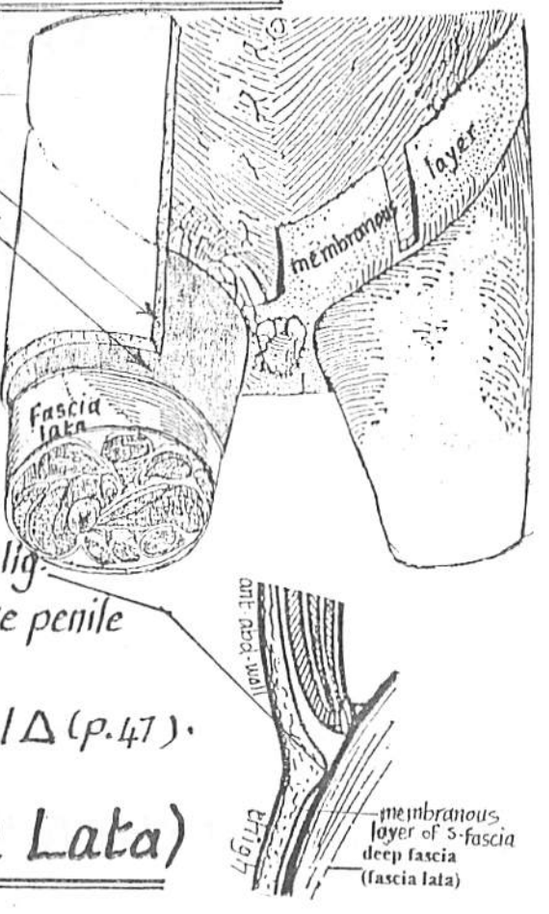
- Arranged: 1st, 2nd, 3rd, 4th & 5th from med. to lat.
- each one has: (a) base proximally (b) head distally (c) shaft inbetween
- the 1st is the thickest metatarsal bone
- the base of the 5th has a projection called tuberosity of base of 5th metatarsal
- the bases of the 1st, 2nd & 3rd metatarsals articulate with the 3 cuniform bones while the bases of the 4th & 5th metatarsals articulate with the cuboid bone.

C - The Phalanges (14)

- 2 for the big toe: proximal & distal
- 3 for each of the lat. 4 toes: proximal, middle & distal.
- each phalanx is composed of; (a) proximal end or base
 (b) shaft (c) distal end or head.

Anteromedial aspect of the thigh

1. Superficial fascia



***Structure:**

- It is differentiated into → (1) superficial fatty layer
 → (2) deep membranous layer
- The 2 layers are continuous with the corresponding layers in the ant. abdominal wall.
- Between the 2 layers lie the superficial nerves, vessels & L.Ns in the upper part of the thigh.

NB: the deep membranous layer is firmly attached to the deep fascia of the thigh along a line just below the inguinal lig. This fusion prevents the escape of urine to the thigh if the penile urethra is injured.

***Contents** of the superficial fascia: see roof of femoral Δ (p. 47).

2- Deep Fascia (Fascia Lata)

***Definition:**

it is a very strong fibrous sheet that envelops the whole thigh like a stocking extending from the root of the lime above to the knee below

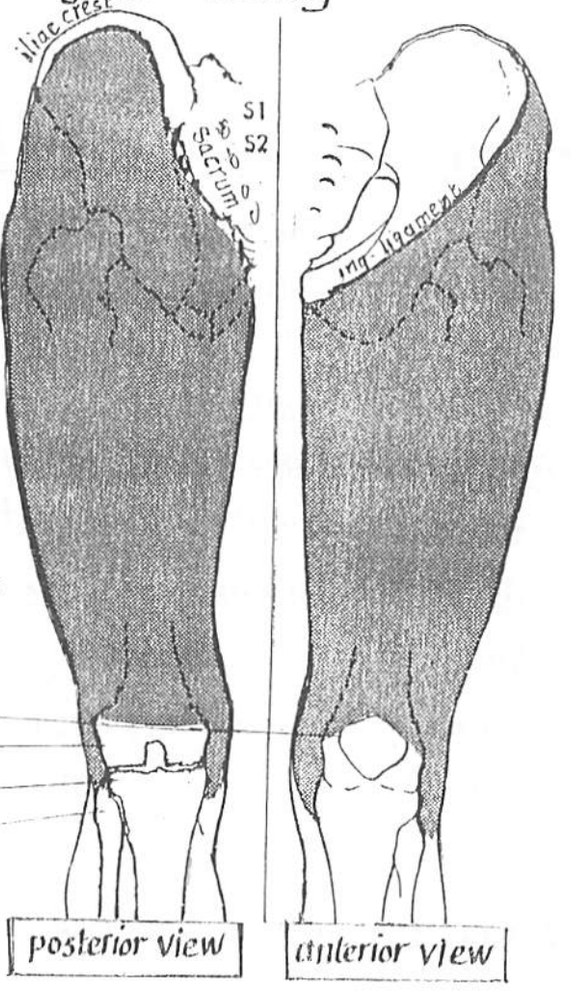
***Attachments:**

(A) **Superiorly**: attached to the hip bone & its ligaments as follows

(1) infront: attached to the inguinal lig. & symphysis pubis
(2) laterally: " " the outer lip of the iliac crest
(3) behind: " to the back of sacrum & coccyx, sacro-tuberous lig.
(4) medially: to the conjoined ischio-pubic ramus.

(B) **Inferiorly**: it is attached to the bony prominences around the knee i.e:

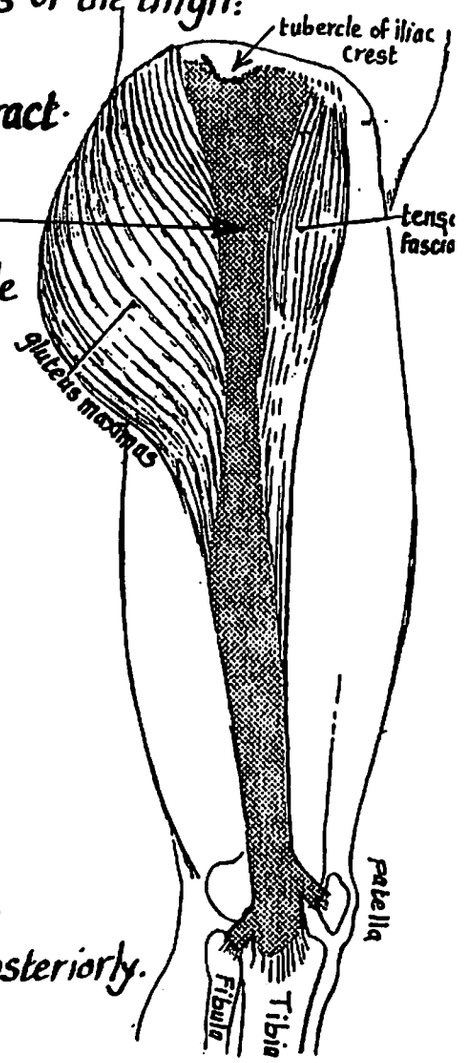
(1) the patella
(2) the 2 femoral condyles
(3) the 2 tibial condyles
(4) the head of fibula



* Thickenings of fascia lata :

The fascia lata varies in thickness in the different parts of the thigh:

- It is thin on the med. & post aspects.
- It is very thick on the lat. aspect forming the **iliotibial tract**.



Iliotibial tract

* **definition**: it is a thickened band of fascia lata 1-2" wide lying on the lat. aspect of the thigh.

* **Attachments**:

(1) **Above**: to the tubercle of iliac crest.

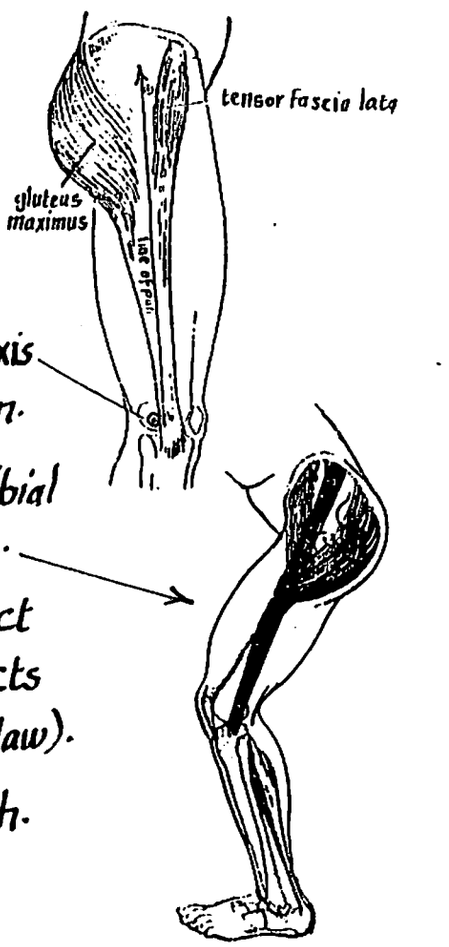
(2) **Below**: it is attached to:

(a) ant. part of lat. condyle of tibia
(b) lat. border of the patella.
(c) head of fibula.
(d) Capsule of the knee joint.

* Structures attached to the iliotibial tract:

(1) the insertion of tensor fascia lata muscle anteriorly.
(2) " " " superficial 3/4 of gluteus maximus m. posteriorly.
(3) the lat. intermuscular septum: to its deep surface.

* Functions of the iliotibial tract:



(1) Extends (prolongs) the insertion of gluteus maximus & tensor fascia lata muscles downwards to reach below the knee joint. This allows the 2 muscles to act on both hip & knee joints

(2) When the knee is straight the tract passes infront of the axis of flexion, thus it maintains the knee in the extended position.

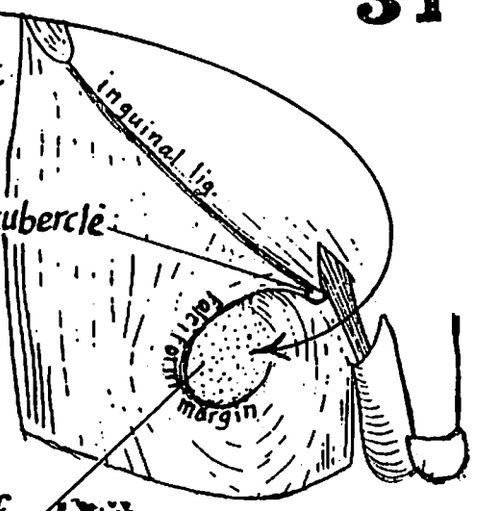
(3) In leaning forwards with the knee slightly flexed, the iliotibial tract is the only antigravity force which supports the knee.

(4) in rising from sitting position, the pull of the iliotibial tract elongates the powerful gluteus maximus m., which contracts more forcibly as the movement proceeds (according to Starling law).

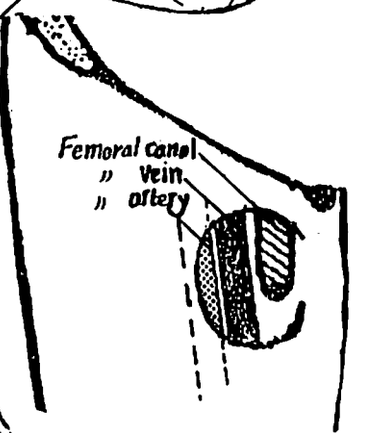
* **Nerve Supply of iliotibial tract**: lat. cut. n. of the thigh.

Saphenous opening

It is an oval opening in the fascia lata in the upper part of the front of the thigh.



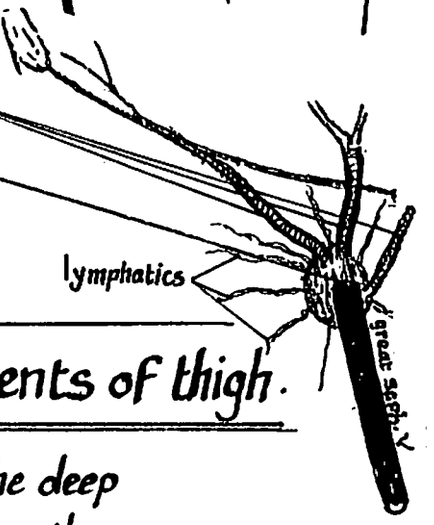
* **Site**: its centre lies $1\frac{1}{2}$ inches below & lat. to the pubic tubercle.
* **Size**: 3 cm x $1\frac{1}{2}$ cm.
* **Margins**: it has sharp upper, lateral & lower margins which form the falciform margin of the saphenous opening. The med. margin is ill defined.
* **Overlying fascia**: the opening is closed by a thin layer of perforated fascia called **cribriform fascia**



* **Underlying structures**:
 (1) the femoral a. : lies behind the lat. margin of the opening
 (2) " femoral v. : behind the centre of the opening
 (3) " femoral canal : " " medial part of the opening

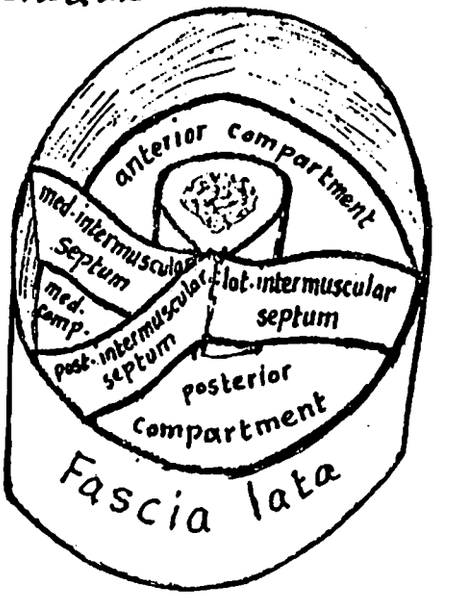
* **Structures passing through the opening**:

(1) superficial inguinal arteries (from femoral a.):
(2) great saphenous v. (to end in the femoral v.):
(3) lymphatic vessels passing from the superficial inguinal L.Ns to the deep inguinal L.N.s



Intermuscular Septa & Compartments of thigh.

3 intermuscular septa (med., lat. & post.) extend from the deep surface of the fascia lata to be attached to the linea aspera & the supracondylar ridges of the femur.:



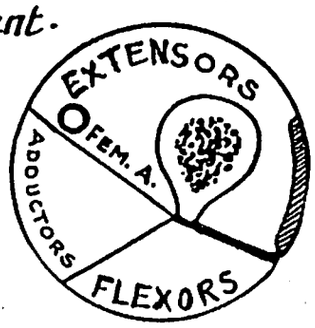
(1) **Lateral intermuscular septum**:
- it is the strongest of the 3 septa
- it extends from the gluteal tuberosity above to the lat. supracondylar ridge below.
- it is attached laterally to the iliotibial tract.
- " " " medially to the linea aspera.
- it separates the ant. compartment from the post. compartment of the thigh.

(2) **Medial intermuscular Septum:**

- it is thinner & shorter than the lat. septum, being well developed below.
- it extends from below the lesser trochanter down to the med. supracondylar ridge.
- it separates the ant. compartment from the med. compartment.

(3) **Posterior intermuscular septum:**

- it is the thinnest of the 3 septa & may be absent.
- it lies between the med. & post. compartments of the thigh



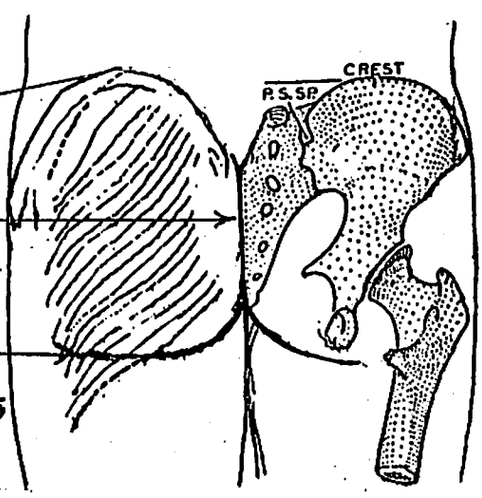
Compartments of the thigh

Compartment	muscles	nerve
Anterior	Extensors of the knee joint Flexors of the hip joint	Femoral n.
Medial	Adductors of the hip joint	Obturator n.
Posterior	Flexors of the knee (hamstring muscles)	Sciatic n.

Gluteal Region

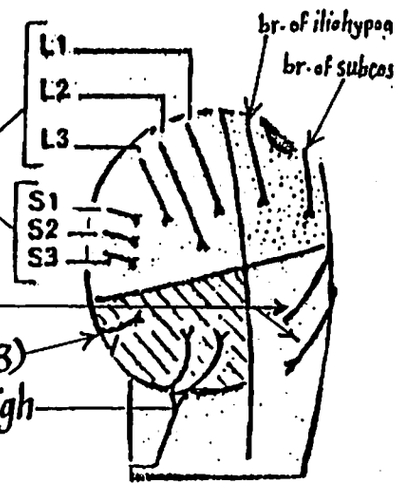
* **Extensions:**

(1) superiorly : the iliac crest
(2) medially : the natal cleft
(3) laterally : line between A.S.I.S & greater trochanter
(4) inferiorly : a transverse crease called the gluteal fold
(it does not correspond to lower border of gluteus maximus muscle).



Cutaneous nerves of gluteal region

(1) The upper & ant. part is supplied by the lat. cut. brs. of the subcostal (T12) & iliohypogastric (L1) nerves.
(2) the upper & post. part is supplied by < post. ry rami of L1,2,3
» » » » S1,2,3
(3) the lower & ant. part is supplied by brs. from post. divisions of lat. cut. n. of the thigh (L2,3)
(4) » » & post. part is supplied by < perforating cut. n. (S2,3)
brs. of post. cut. n. of thigh (S1,2,3)



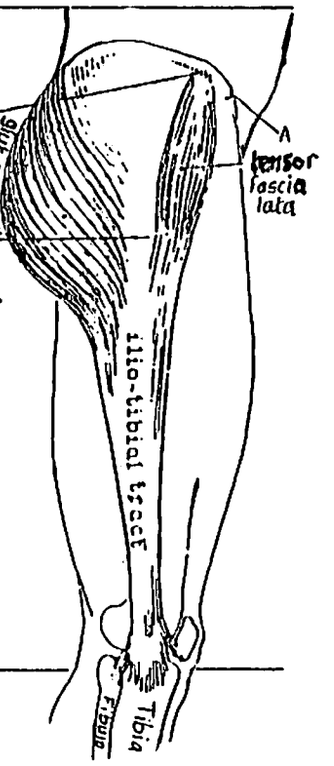
Muscles of the gluteal region

A- Tensor fascia lata muscle

B- the 3 gluteal muscles
(1) gluteus maximus
(2) » medius
(3) » minimus

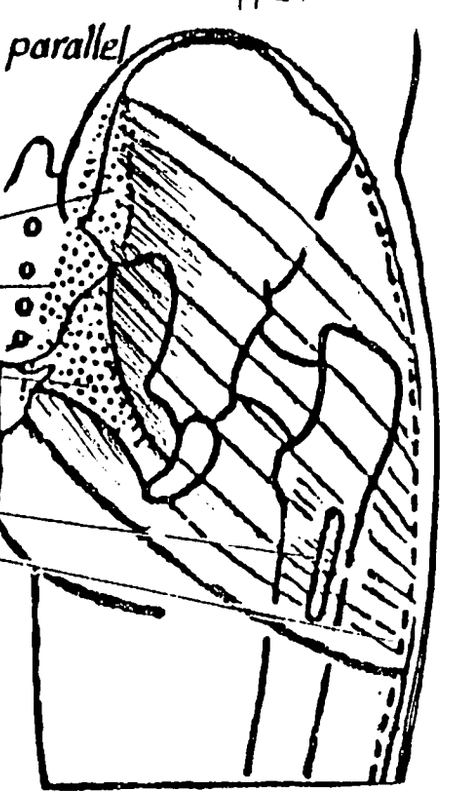
C- 6 lat. rotators:
(1) piriformis
(2) obturator internus.
(3) obturator externus.
(4), (5) 2 gemelli (sup. & inf.)
(6) quadratus femoris

Tensor fascia lata m.



* **Origin**: From the ant. 5 cm of the outer lip of the iliac crest (just behind the a.s.i.s)
* **Insertion**: into the ant. border of the iliotibial tract
 N.B: the tract splits into 2 lamellae which enclose the muscle.
* **N. supply**: Sup. gluteal n. (L 4,5 & S1).
* **Action**: (1) it is a tensor of the fascia lata & iliotibial tract.
 (2) maintains the erect posture by steadying the pelvis on the head of femur & steadying the femur on the tibia.
 (3) helps abduction of the hip.
 (4) » extension of the knee.

Gluteus Maximus m.



* It is a thick powerful quadrilateral m. formed of coarse parallel fibres which run downwards & laterally.
* **Origin**:
 (1) gluteal surface of ilium behind the post. gluteal line.
 (2) back of lat. mass of Sacrum.
 (3) » » the sacrotuberous lig.
* **Insertion**:
 (1) its deep 1/4: into the gluteal tuberosity of femur
 (2) » superficial 3/4: into the post. border of the iliotibial tract.
* **N. supply**: inf. gluteal n. (L 5, S 1, 2).
* **Action**:

(A) Acting from above:

(1) it is the main extensor of the hip joint particularly when force is needed e.g in rising from sitting position, in climbing upstairs & in running.

(2) it is a strong lat. rotator & abductor of thigh.

(3) it tightens the iliotibial tract thus helping to extend the knee & steady femur on tibia

(B) **Acting from below**: it can raise the body from stooping position (acting with hamstrin

Structures undercover of gluteus maximus

(deep relations of gluteus maximus)

(A) Bony parts:

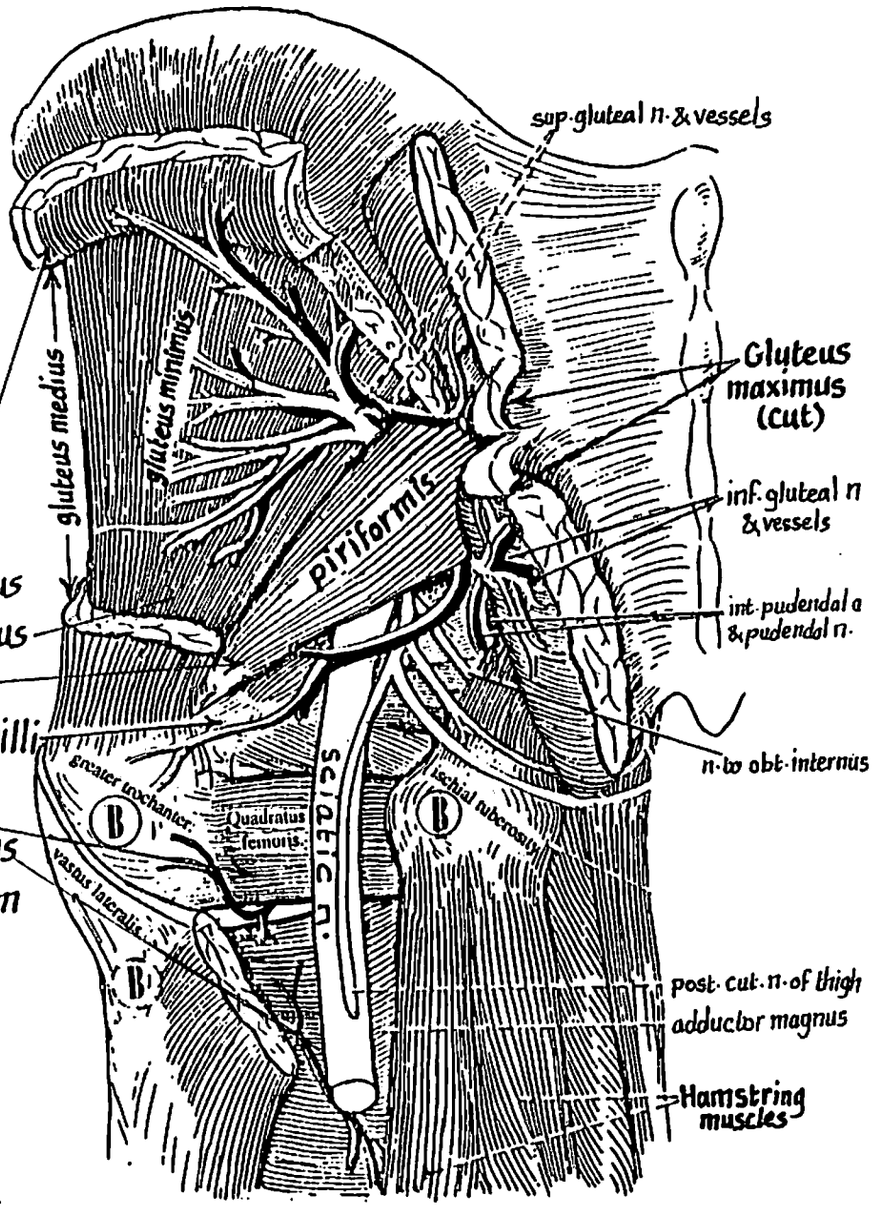
- back of ilium & sacrum.
- greater trochanter.
- gluteal tuberosity.
- ischial tuberosity.

(B) Ligaments:

- Sacrotuberous lig.
- Sacrospinous lig.
- back of capsule of hip joint.

(C) Muscles:

- other 2 gluteii: glut. medius, " minimus
- piriformis
- obturator internus & the 2 gemilli
- quadratus femoris
- ischial part of adductor magnus
- origin of hamstring muscles from the ischial tuberosity.



(D) Vessels:

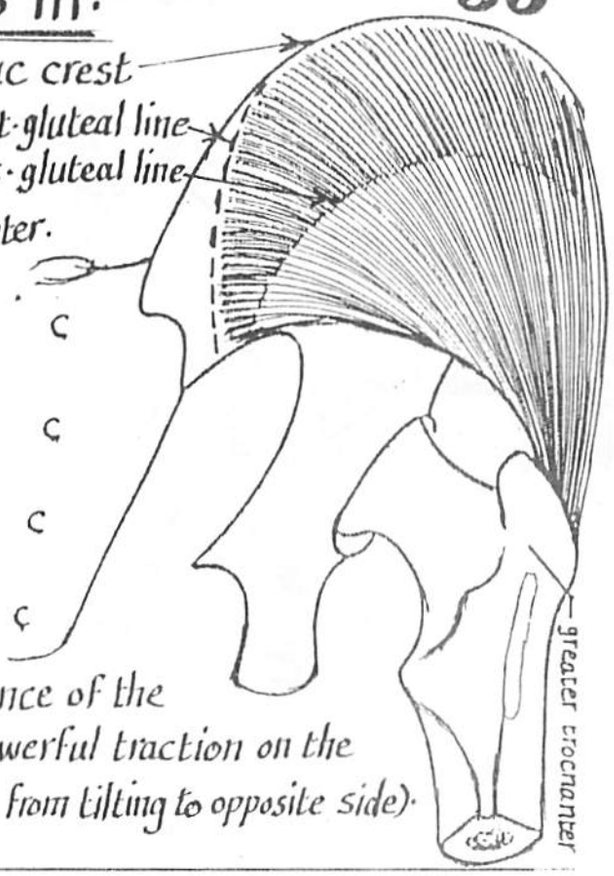
- sup. gluteal vessels.
- inf. " " .
- internal pudendal vessels

(E) Nerves: — sup. & inf. gluteal nn.
sciatic n. & post. cut. n. of thigh
pudendal n. & n. to obturator internus
n. to quadratus femoris

(F) Bursae: (1) bursa on greater trochanter.
(2) " " ischial tuberosity.
(3) " " the upper part of vastus lateralis m.

Gluteus Medius m.

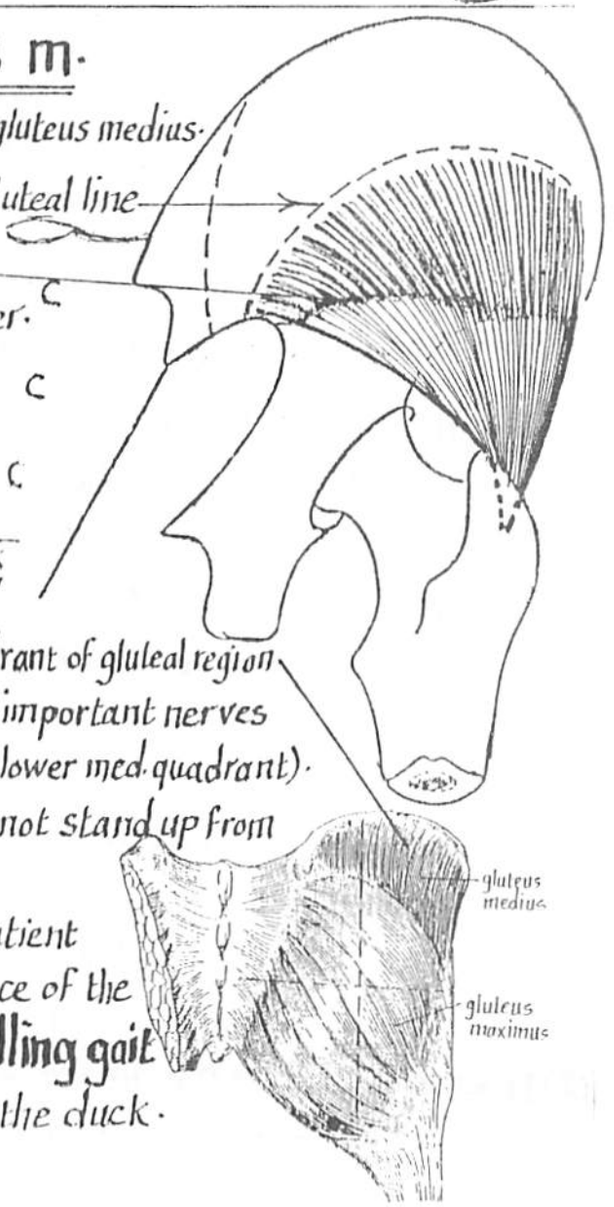
* **Origin** : gluteal surface of ilium between:- iliac crest
 - post. gluteal line
 - ant. gluteal line
* **Insertion**:
 - posterosuperior angle of greater trochanter.
 - oblique ridge on lat. surface of » »
* **N. Supply**: Sup. gluteal n.
* **Action** :
 (A) acting from above:
 (1) the whole muscle : abduction of the thigh.
 (2) » thick ant. part : med. rotation » » » .
 (3) acting from below:
 together with gluteus minimus, it maintains the balance of the pelvis when the other leg is raised by exerting a powerful traction on the hip bone on the same side (thus preventing the pelvis from tilting to opposite side).



Gluteus Minimus m.

It is a fan-shaped muscle lying deep to ant. part of gluteus medius.

* **Origin** : gluteal surface of ilium between ant. gluteal line & inf. gluteal line
* **Insertion**: ant. surface of greater trochanter.
* **N. Supply** : Sup. gluteal n.
* **Action** : the same as gluteus medius.



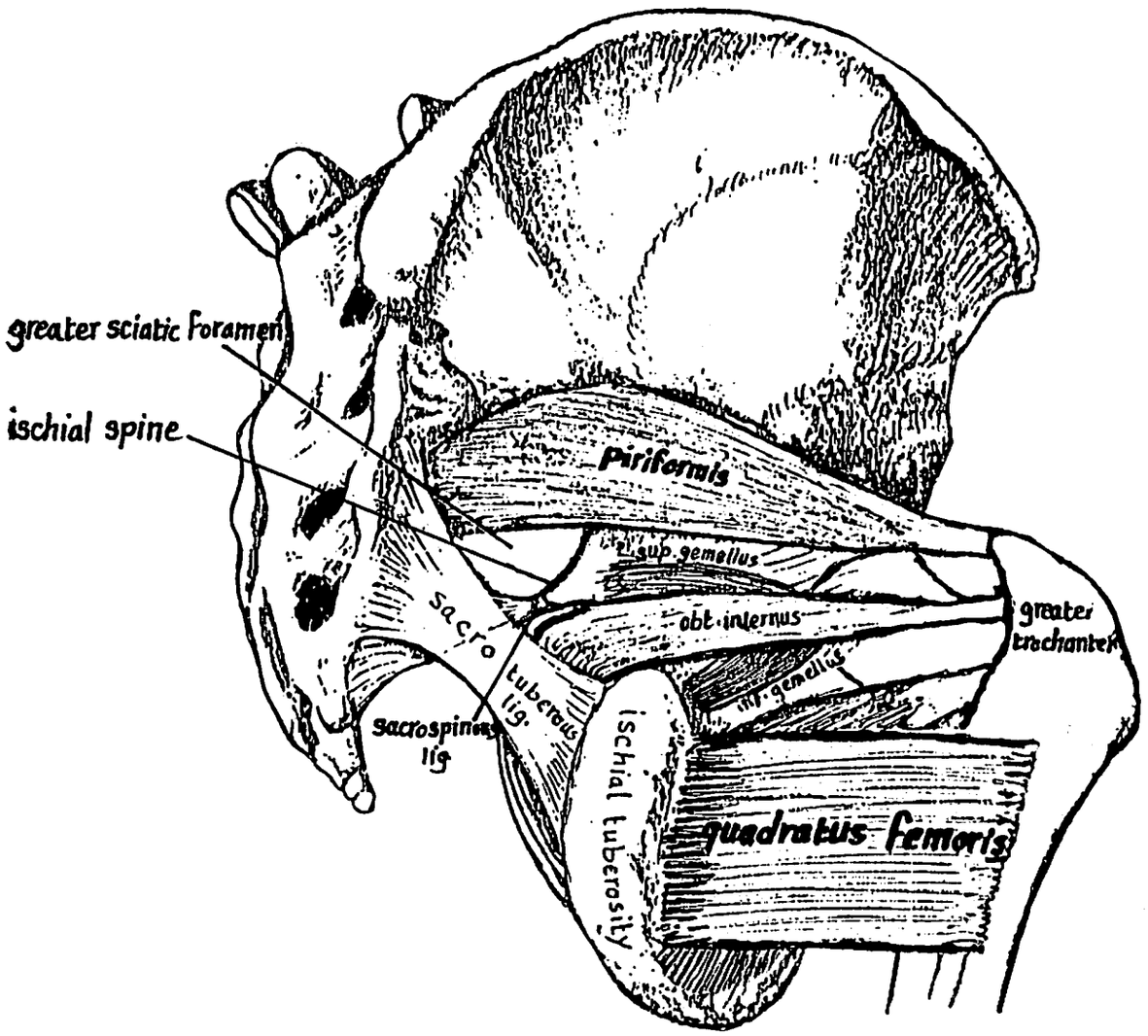
* **Applied anatomy** of gluteal muscles:

(1) intramuscular injection is given in the upper lat. quadrant of gluteal region (i.e in the glutei medius & minimus) to avoid injury of important nerves & vessels undercover of gluteus maximus (mainly in the lower med. quadrant).

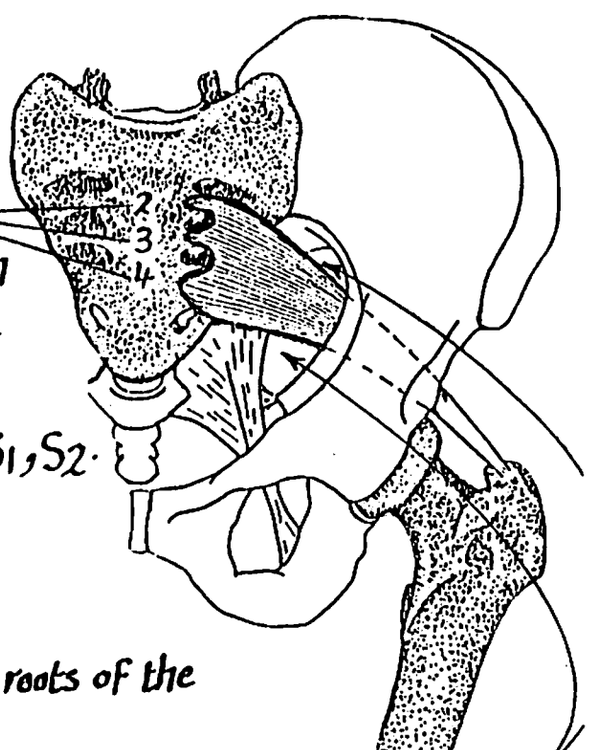
(2) when gluteus maximus is paralysed, the patient cannot stand up from a sitting position without a support.

(3) when the glutei medius & minimus are paralysed, the patient cannot walk normally because they maintain the balance of the pelvis during walking. Their paralysis lead to **Waddling gait** (i.e the patient sways (waddles) from side to side like the duck.

The 6 Lateral Rotators of the hip



(1) Piriformis m.

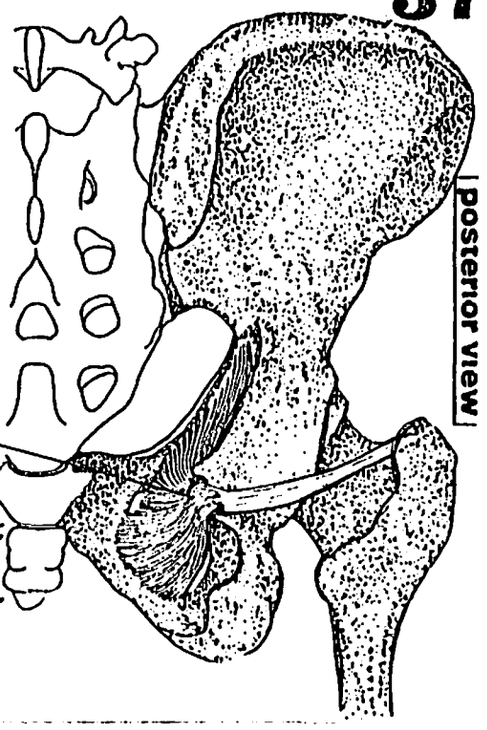


* **Origin**: inside the pelvis, from the ant. surface of the middle 3 sacral pieces
* **Course**: it emerges from the greater sciatic foramen
* **Insertion**: into the upper border (top) of the greater trochanter
* **N. supply**: inside the pelvis, by branches from S_1, S_2.
* **Action**: lateral rotation of the thigh.
* **Relations**:
 (1) **In the pelvis**: it is related anteriorly to the roots of the sacral plexus.
 (2) It emerges from the greater sciatic foramen dividing it into upper & lower parts

(see page 38 for structures passing above & below piriformis).

2- Obturator internus m.

* **Origin**: inside the pelvis from:
 (1) inner surface of the obturator membrane.
 (2) front & side walls of pelvic cavity around the margins of the obturator foramen.
* **Course**: its tendon emerges from the pelvis through the lesser sciatic foramen, bends at right angle & runs laterally across the back of hip joint.
* **Insertion**: into the med. surface of the greater trochanter.
* **N. Supply**: n. to obturator internus (from sacral plexus).
* **Action**: lat. rotation of thigh.

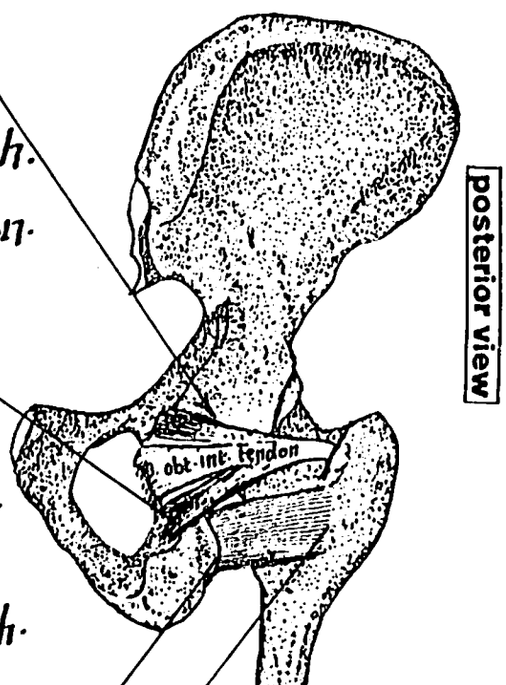


3- Superior Gemellus m.

* **Origin**: upper boundary of the lesser sciatic notch.
* **Insertion**: upper border of obturator internus tendon.
* **N. Supply**: n. to obturator internus.

(4) Inferior Gemellus m.

* **Origin**: lower boundary of the lesser sciatic notch.
* **Insertion**: lower border of obturator internus tendon.
* **N. Supply**: n. to quadratus femoris m.
* **Action of the 2 Gemilli**: weak lat. rotators of the thigh.

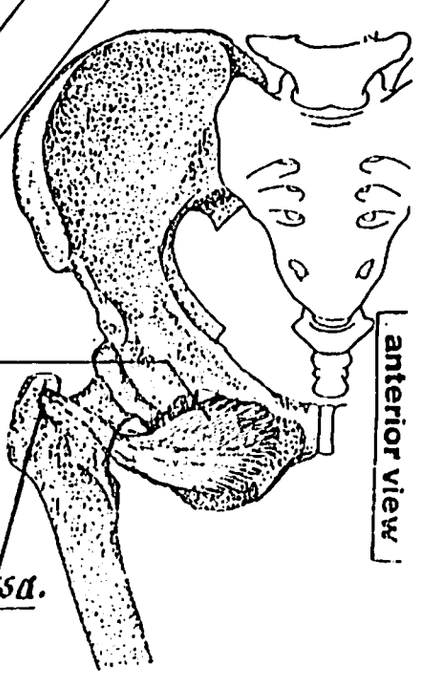


(5) Quadratus femoris m.

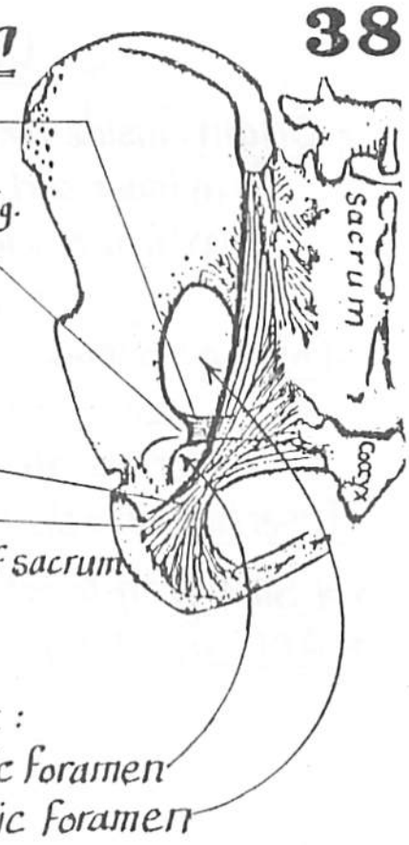
* **Origin**: lat. border of upper part of ischial tuberosity.
* **Insertion**: quadrate tubercle of femur & the bone below it.
* **N. Supply**: n. to quadratus femoris.
* **Action**: lat. rotation of the thigh.

(6) Obturator externus m.

* **Origin**: outer surface of the obturator membrane + the outer margins of the obturator foramen
* **Insertion**: its tendon passes below then behind the neck of femur & hip joint to be inserted into the trochanteric fossa.
* **N. Supply**: post. division of obturator n.
* **Action**: lat. rotation of the thigh.



Ligaments of the gluteal region



(1) Sacrospinous ligament :

- it is a short thick triangular lig. lying deep to the sacrotuberous lig.
- its apex (lat. end) is attached to the ischial spine
- its base (med. end) is attached to the last piece of sacrum & 1st piece of coccyx.

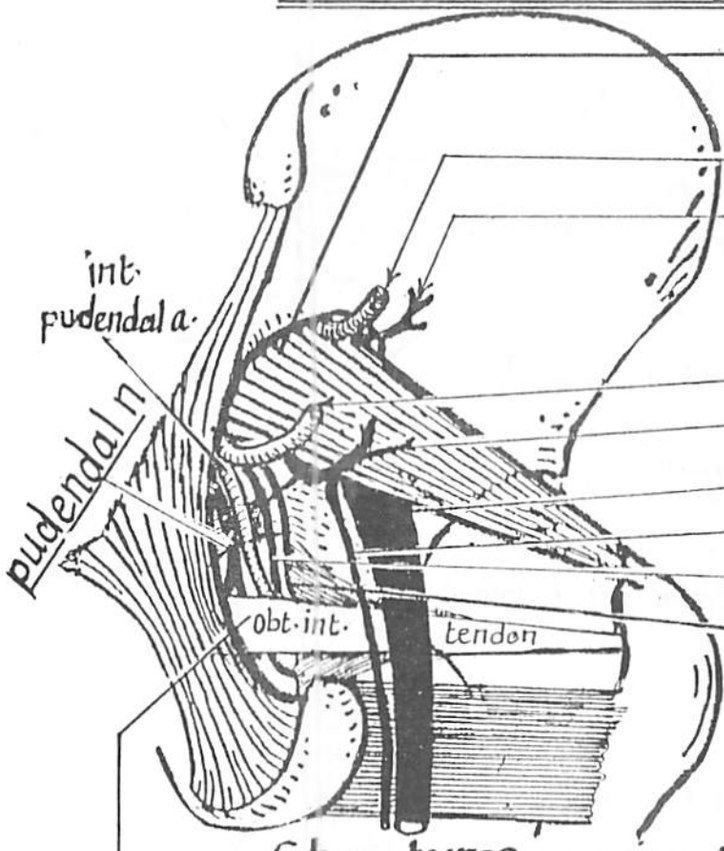
(2) Sacrotuberous ligament :

- it is a long strong band which is attached :
 - (a) inferiorly : to the medial margin of the ischial tuberosity
 - (b) Superiorly : to the post. segment of the iliac crest, lat. border of sacrum & coccyx

Foramina of the Gluteal region

The sacrospinous & sacrotuberous ligaments convert :
- (a) the lesser sciatic notch into ⟶ lesser sciatic foramen
- (b) the greater » » » ⟶ greater sciatic foramen

Structures passing through greater sciatic F.



- (A) Piriformis m.
- (B) Structures above piriformis:
 - (1) sup. gluteal vessels.
 - (2) sup. gluteal nerve.
- (C) Structures below piriformis:
 - (1) inf. gluteal vessels.
 - (2) inf. gluteal nerve.
 - (3) sciatic nerve.
 - (4) post. cut. n. of thigh.
 - (5) n. to obturator internus.
 - (6) n. to quadratus femoris.
 - (7) internal pudendal vessels
 - (8) Pudendal n.

Structures passing through lesser sciatic F.

(1) Tendon of obturator internus : emerges from the pelvis to the gluteal region.

(2) Structures emerging from the greater sciatic F. & entering the lesser sciatic foramen :
- (a) n. to obturator internus : lat. in position, crossing the ischial spine.
- (b) Int. pudendal vessels : intermediate in position, » » tip of the ischial spine.
- (c) Pudendal n. : medial in position, crossing the sacrospinous lig.

Comment on the structures passing through greater & lesser sciatic foramina

(1) **piriformis** muscle : see page 36.

(2) **Sup. gluteal n.** (L4,5,S1):
- it is a branch of the sacral plexus
- it leaves the pelvis by passing through greater sciatic foramen above piriformis m.
- it runs forwards between gluteus medius & minimus (supplying both muscles).
- it ends by supplying the tensor fascia lata muscle.

(3) **Sup. gluteal a.** :
- it is a br. of post. division of internal iliac a. inside the pelvis.
- it emerges from the greater sciatic foramen above piriformis m.
- it ends by dividing into:
 (a) superficial division : supplies gluteus maximus m.
 (b) deep " : subdivides into sup. & inf. brs. running between glutei medius & minimus:
 (1) sup. br. runs along the ant. gluteal line to end at the A.S.I.S (sharing in the anastomosis there).
 (2) inf. br. " " " inf. gluteal line to end by joining the trochanteric anastomosis (p. 77).

(4) **Inf. gluteal n.** (L5,S1,2):
- it is a branch of the sacral plexus.
- it leaves the pelvis by passing through greater sciatic f. below piriformis m.
- it ends by supplying the gluteus maximus m.

(5) **Inf. gluteal a.** :
- it is a br. of the ant. division of the internal iliac a.
- it accompanies the inf. gluteal n. (supplying gluteus maximus).
- it gives articular br. to hip joint, artery to the sciatic n. & br. to cruciate anastomosis.

(6) **Sciatic nerve** : see page 96 for its course in the gluteal region.

(7) **Post. cut. n. of thigh** :
- it is a br. of sacral plexus which emerges through greater sciatic f. below piriformis m.
- it descends on the dorsal surface of sciatic n., covered superficially by gluteus maximus m.
- at the origin of the hamstrings, it leaves sciatic n. by passing superficial to the long head of biceps m. then continues on the back of thigh just deep to the deep fascia.

(8) **N. to obturator internus** (br. of sacral plexus):
- emerges from greater sciatic f. below piriformis the enters the lesser sciatic f.
- it supplies obturator internus m. + sup. gemellus m.

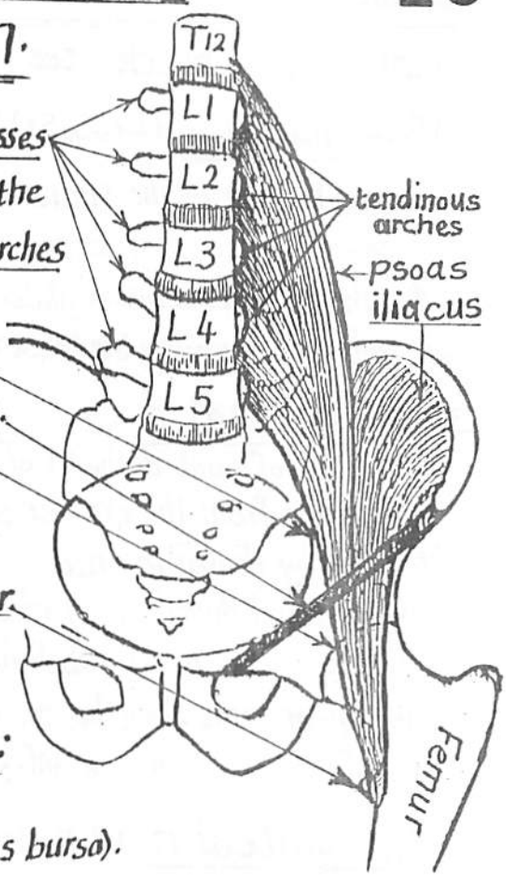
(9) **N. to Qudratus femoris** : descends on the back of ischium deep to sciatic n., obt. int. & the 2 gemelli to end by supplying quadratus femoris + inf. gemellus m.

(10) **pudendal n.** (br. of sacral plexus) : emerges from greater sciatic f., enters lesser sciatic.

(11) **Int. Pudendal a.** (br. of ant. division of int. iliac a) : it accompanies the pudendal n.

Muscles of the Iliac region

(1) Psoas Major m.



* **Origin**: inside abdomen from:
(1) ant. surfaces & lower borders of all lumbar transverse processes
(2) sides of bodies of last thoracic & all lumbar vertebrae and the intervening intervertebral discs & tendinous arches

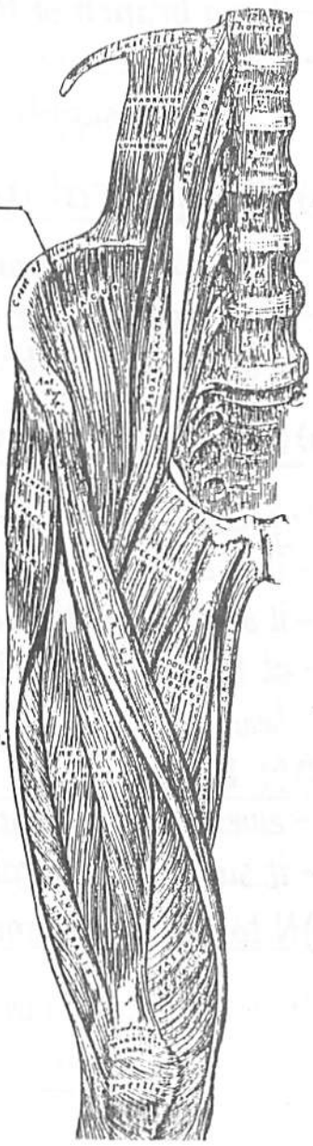
* **Course**:
- it descends along the lumbar vertebrae then pelvic brim
- the lower part of the muscle leaves abd. deep to inguinal lig. closely related to iliacus m. & ant. to the capsule of hip joint

* **Insertion**: together with iliacus m. it forms iliopsoas tendon inserted into lesser trochanter of femur.

* **N. supply**: L1, 2, 3 (directly from the lumbar plexus.

* **Important Relations of Psoas major in the thigh**:
(1) anteriorly: inguinal lig. & femoral sheath
(2) Posteriorly: capsule of hip joint (separated from it by psoas burso).
(3) medially: pectineus m.
(4) laterally: iliacus m., separated from it by the femoral n.
N.B: both psoas & iliacus form the lat. part of the floor of femoral Δ.

(2) ILIACUS M.



* **Origin**: (1) upper 2/3 of the floor of iliac fossa + inner lip of iliac crest.
(2) iliolumbar & ant. sacroiliac ligaments.
(3) adjoining part of ala of sacrum.

* **Insertion**: into the lat. side of psoas major tendon (forming the common iliopsoas tendon inserted into the lesser trochanter).

* **N. Supply**: femoral n. (by br. arising from it inside the abdomen).

*Action of the iliopsoas:

(A) acting from its origin: Flexion of the thigh & med. rotation.
(B) acting from its insertion:
- iliopsoas of one side: lat. flexion of the vertebral column.
- iliopsoas of both sides: flexion of the pelvis over the thigh (as in rising from recumbent position).

N.B: in case of fracture neck of femur, the iliopsoas produces lat. rotation of the thigh.

Muscles of the front of thigh

(1) Sartorius m.

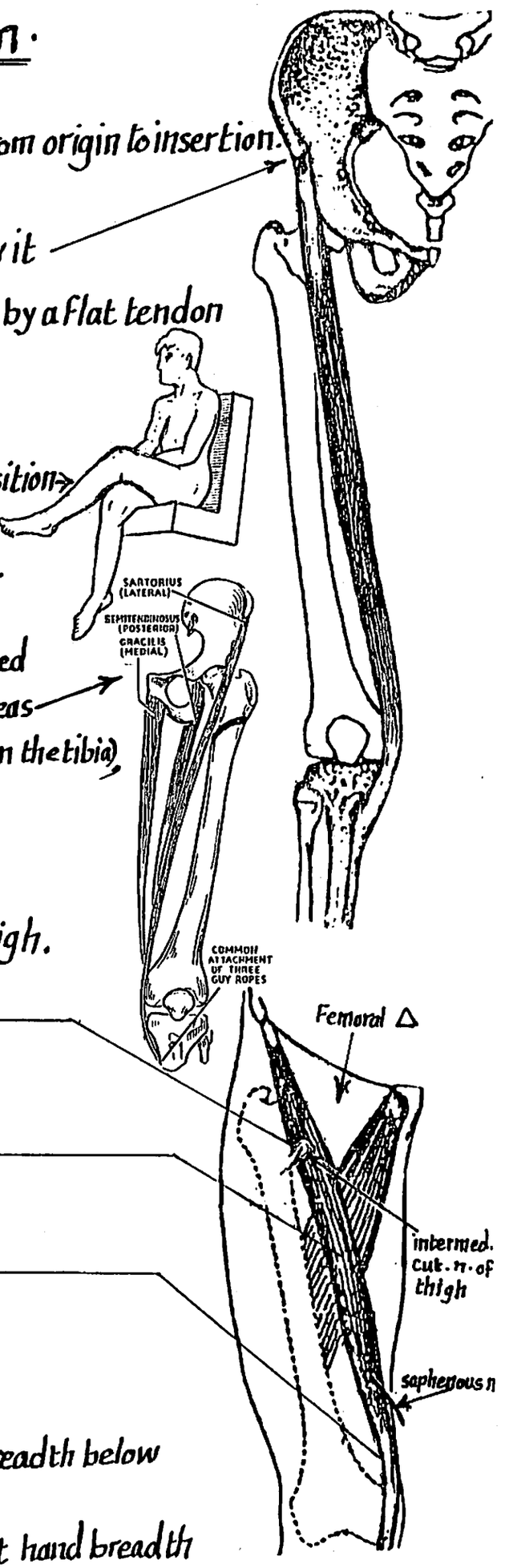
(sartor = tailor)

- It is the **longest m.** in the body & is fleshy from origin to insertion.
- It is strap-like m. with parallel fibres.
- **Origin**: Ant. sup. iliac spine & the notch below it
- **Insertion**: upper part of med. surface of tibia, by a flat tendon
- **N. supply**: femoral n.
- **Action**:

putting the lower limb in the classical cross leg position of tailor by acting on both hip & knee joints as follows:

(a) flexion, abduction & lat. rotation of the thigh.
(b) flexion & med. rotation of the leg.

Sartorius, Gracilis & Semitendinosus (S.G.S) are called the "Guy ropes" because they arise from different areas the mobile pelvis & are inserted into the same area (in the tibia), thus they help to stabilize the mobile pelvis.



Important relations of Sartorius:

it is the most superficial m. in the front of the thigh.

Its upper ⅓ (oblique):
forms the lat. boundary of the femoral triangle

Its middle ⅓ (oblique):
forms the roof of the subsartorial canal.

Its lower ⅓ (vertical):
descends along the med. side of the knee.

2 nerves pierce the sartorius m.:

(a) intermediate cut. n. of thigh: pierces it hand breadth below its origin
(b) Saphenous n. (or its infrapatellar br.) pierces it hand breadth above its insertion

2- Quadriceps m.

* It is the biggest muscle in the body
* It is formed of 4 parts (heads) — rectus femoris (arises from hip bone); vastus intermedius, vastus medialis, vastus lateralis (arise from femur)

A- Rectus Femoris

* **Origin**: from the hip bone by 2 tendinous heads:
 - (1) Straight head: from ant.-inf. iliac spine
 - (2) Reflected " : - from a groove just above the acetabulum
 - from the capsule of the hip joint

the 2 heads unite at an acute angle to form bipennate fusiform muscle which descends infront of the thigh

* **Insertion**: into upper border (base) of the patella

(B)- Vastus intermedius

* **Origin**: (1) upper 3/4 of ant.-& lat.-surfaces of femur.
 (2) lat.-intermuscular septum of the thigh.

(C)- Vastus lateralis

* It is the largest component of quadriceps m.
* **Origin**: it has a continuous linear origin from:
 - upper part of intertrochanteric line
 - ant.-& inf.-borders of the greater trochanter.
 - lat.-lip of gluteal tuberosity.
 - lat lip of upper ½ of linea aspera.

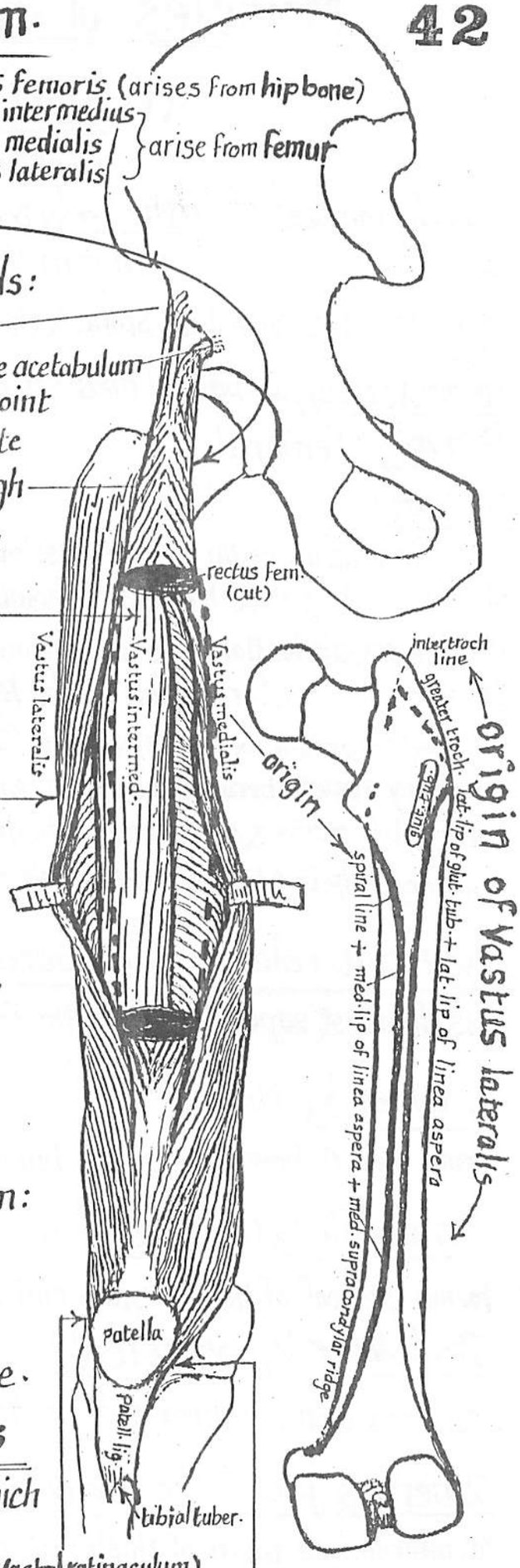
(D)- Vastus medialis

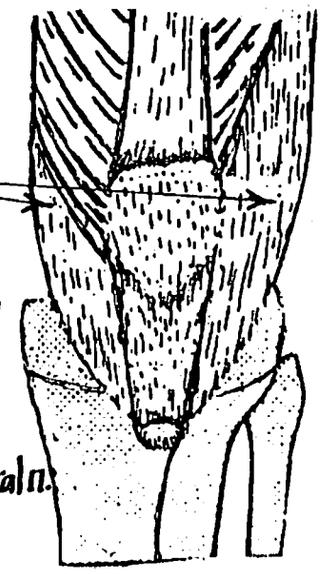
* **Origin**: it has a continuous linear origin from:
 - lower part of intertrochanteric line.
 - spiral line.
 - med.-lip of linea aspera.
 - upper ½ of med.-supracondylar ridge.

Insertion of the quadriceps

(1) The 4 heads join each other forming one mass which is inserted into
- (a) base of the patella
- (b) lat.-side of patella (via lat.-Vastal retinaculum)
- (c) med. " " " (via med.-Vastal retinaculum)

(2) patellar lig. arises from the apex of the patella & passes downwards to get final insertion in the tibial tuberosity.





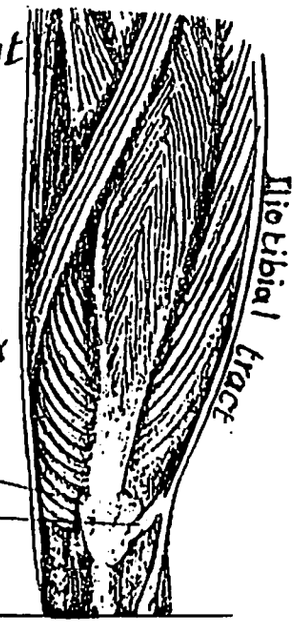
N.B:

(1) expansions from vastus medialis & vastus lateralis go to the respective sides of the fibrous capsule of knee joint

(2) the patella is considered as a Sesamoid bone in the qudriceps tendon

*N.supply: Femoral n.

- each head of quadriceps receives 1-3 separate brs. from femoral n.
- the br. to vastus medialis is the **thickest** as it also carries proprioceptive fibres supplying the knee joint.
- the br. to rectus femoris carries proprioceptive fibres to the hip joint



*Action of the quadriceps m

(1) the whole quadriceps m: is the main extensor of the knee.

(2) Rectus femoris: is a strong flexor of the hip joint (next to iliopsoas) It also flexes the pelvis over the lower limb (it is the chief stabilizer of hip & knee joints).

(3) the distal fleshy fibres of vastus medialis (med. vastal retinaculum) stabilizes the patella by counteracting the lat. pull induced by the iliotibial tract.

Articularis Genu muscle

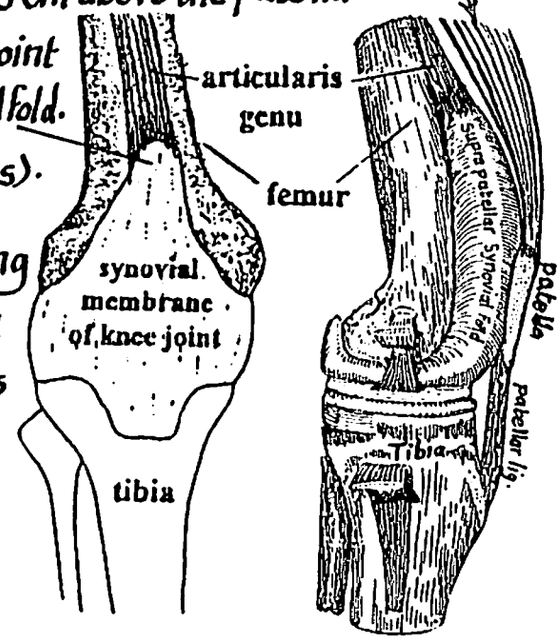
*It is a small slender muscle lying deep to lower part of vastus intermedius m.

*Origin: lower part of ant. surface of shaft of femur 5 cm above the patella.

*Insertion: upper part of synovial membrane of kee joint which bulges up as the suprapatellar synovial fold.

*N.supply: Femoral n. (through n. to Vastus intermedius).

*Action: pulls the synovial membrane upwards during extension of the knee thus preventing it from being insinuated between the articulating bones



MUSCLES OF THE MEDIAL SIDE OF THE THIGH

* They include : gracilis, pectineus & 3 adductors (longus, brevis & magnus)

* **General remarks :**

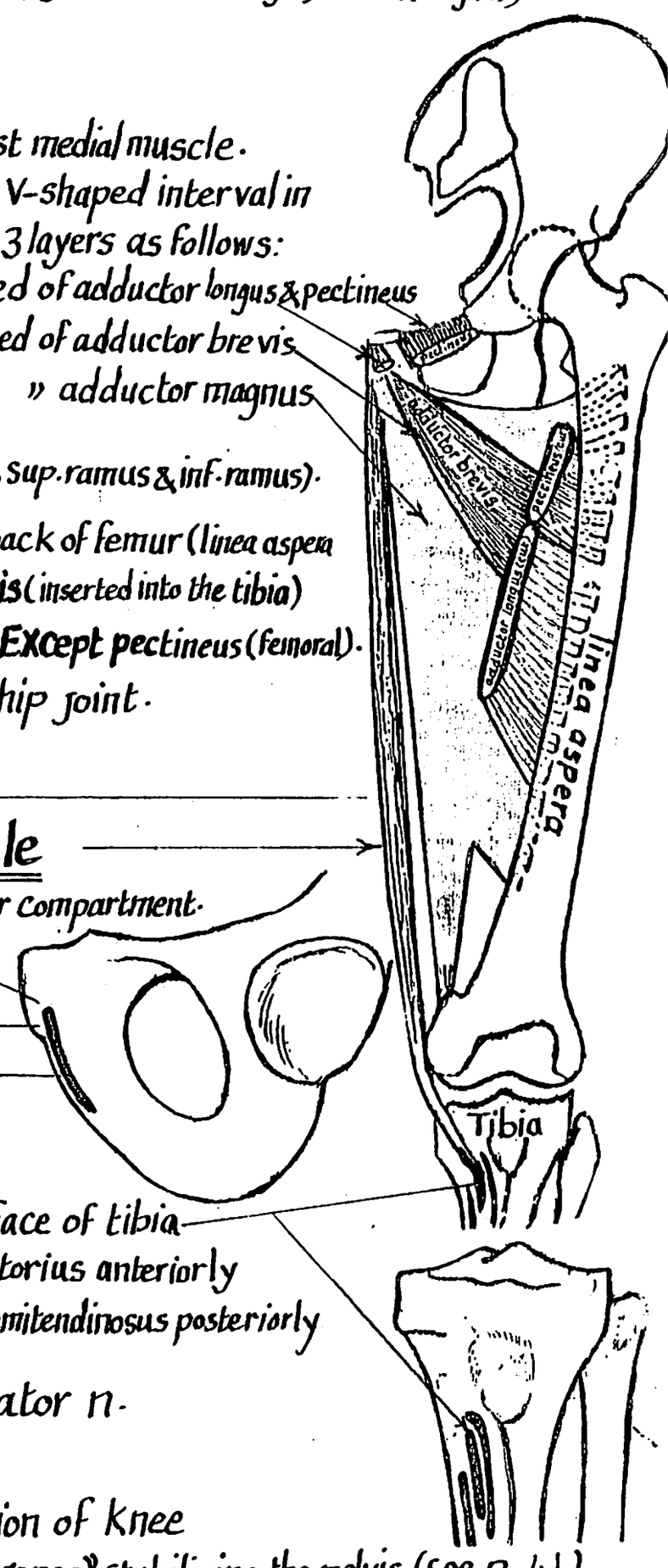
(1) **Arrangement** : gracilis m. is the most medial muscle.
- It forms with the shaft of femur a V-shaped interval in which other muscles are arranged in 3 layers as follows:
 (a) ant. layer : formed of adductor longus & pectineus
 (b) middle layer : formed of adductor brevis
 (c) post. layer : " " adductor magnus

(2) **Origin** : all arise from pubis (body, sup. ramus & inf. ramus).

(3) **Insertion** : all are inserted into the back of femur (linea aspera & its extension) **Except gracilis** (inserted into the tibia)

(4) **N. supply** : all supplied by obturator n. **Except** pectineus (femoral).

(5) **Action** : all are adductors of the hip joint.



(1) Gracilis muscle

* It is the most medial m. of the adductor compartment.

* **Origin** : (1) lower part of body of pubis
 (2) inferior pubic ramus
 (3) upper part of ischial ramus

* **Insertion** :
 into upper part of med. surface of tibia (between the insertion of sartorius anteriorly & semitendinosus posteriorly

* **N. supply** : ant. division of obturator n.

* **Action** : (1) adduction of thigh
 (2) flexion & med. rotation of knee
 (3) it is one of the 3 "Guy ropes" stabilizing the pelvis (see p. 41).

2- Pectineus m.

* **Origin**: pectineal line & surface of sup. pubic ramus
* **Insertion**: upper ½ of pectineal line of femur which extends from lesser trochanter to the linea aspera
* **N. Supply**: - Femoral n. (mainly)
 - br. from obturator (or accessory obturator n.) occasionly supplies its post. part.
* **Action**: (1) adduction of the hip joint.
 (2) Flexion of hip joint (considered as detached part of psoas).
* **imp. relations**: (1) it forms part of the floor of femoral Δ.
 (2) it is related anteriorly to the femoral sheath
 (3) " " " posteriorly to obturator externus m.

3- Adductor longus m

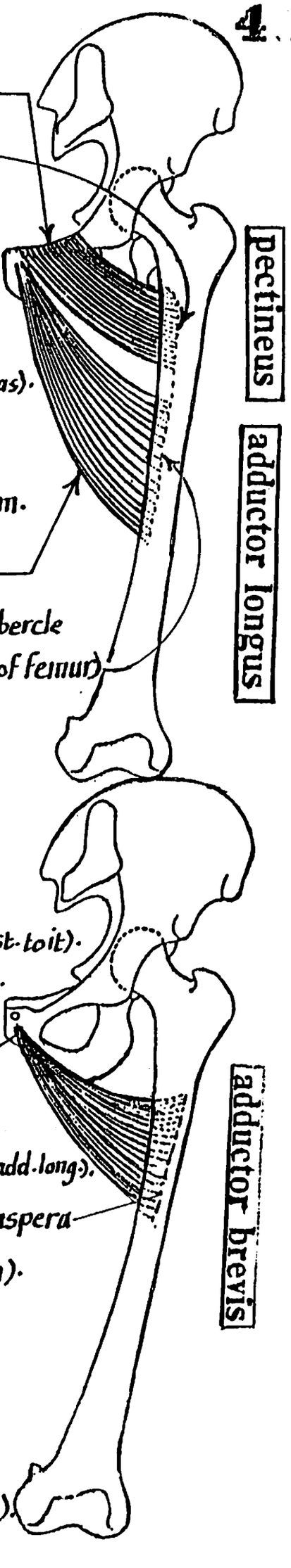
* **Origin**: by rounded tendon from body of pubis just below pubic tubercle
* **Insertion**: into linea aspera (in the middle ⅓ of back of shaft of femur)
* **N. supply**: ant. division of **obturator n.**
* **Action**: (1) adduction of thigh (2) helps flexion of thigh
 (3) ? med. rotation of thigh.
* **Imp. relations**:

(1) the muscle forms the med. part of the floor of the femoral Δ
(2) " " separates femoral vessels (ant. to it) from profunda vessels (post. to it).
(3) its tendon of origin may be partially ossified in horse riders (rider bone).
(4) " " " " is a landmark to the pubic tubercle

4- Adductor brevis m.

* **Origin**: front of body of pubis & inf. pubic ramus (below origin of add. long.).
* **Insertion**: lower part of pectineal line + upper part of linea aspera
* **N. Supply**: Obturator n. (either the ant. or the post. division).
* **Action**: - adducts & helps Flexion of the thigh.
 - ? med. rotation of the the thigh.
* **Imp. relations**:

(1) the muscle lies deep to adductor longus & pectineus.
(2) " " separates the ant. division of obturator n. (ant. to it) from post " " " " (post. to it).



5- Adductor Magnus m.

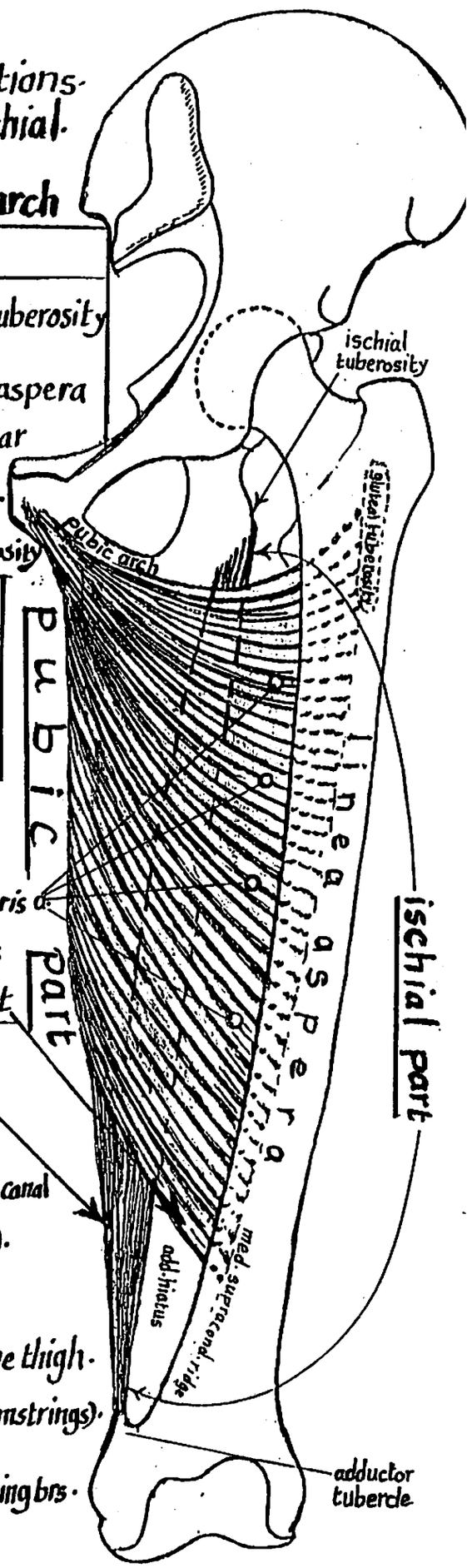
- It it the biggest & most powerful adductor
- It has 2 origin, 2 insertion, 2 nerve supply & 2 actions. it is considered as formed of 2 parts: pubic & ischial.

I- the pubic part: arises from pubic arch

Origin	Course	insertion
inf. pubic ramus	horizontal	med. lip of gluteal tuberosity
ischial ramus	oblique	- med. lip of linea aspera - med. supracondylar ridge

II- the Ischial Part: from ischial tuberosity

origin	Course	Insertion
It. area of lower part of ischial tuberosity	Vertical	adductor tubercle of femur



NB:

(1) The insertion of the pubic part is interrupted by the passage of the perforating branches of the profunda femoris a.

(2) the Adductor Hiatus is an opening in adductor magnus lying between the lower end of the insertion of the pubic part & the lower end of the insertion of the ischial part.

- The hiatus lies at the junction between the upper 3/4 & the lower 1/4 of the med. side of thigh. This opening gives passage to femoral vessels & the contents of subsartorial canal

* **N. supply:**
- pubic part: obturator n. (post. division).
- ischial " : Sciatic n. (tibial part).

* **Action:**
- pubic part: adduction & med. rotation of the thigh.
- ischial part: Extension of hip joint (like hamstrings).

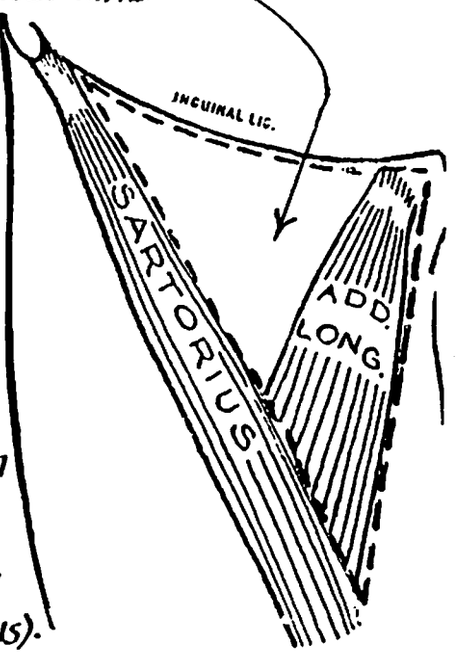
* **Imp. relations:**

(1) ant. surface related to:
- termination of profunda a. & its perforating brs.
- femoral a.
- post. division of obturator n.

(2) post. " " " : sciatic n. & anastomosis between the perforating brs. of profunda.

Femoral Triangle

it is the largest intermuscular space in the lower limb.



* **Site**: it lies in the upper ⅓ of front of thigh just below the inguinal lig.
* **Shape**: a shallow triangular depression with base above & apex below.
* **Boundaries**:
 - laterally: med. border of sartorius m.
 - medially: med. border of adductor longus m.
 - base (above): formed by the inguinal lig. (extending from the A.S.I.S & the pubic tubercle
 - apex (below): is formed by the meeting point of the med. & lat. borders (sartorius overlapping adductor longus).

- **Roof**: is formed of { skin & superficial fascia with its contents of vessels, nerves & L. Ns; deep fascia (fascia lata) containing the sapenous opening.

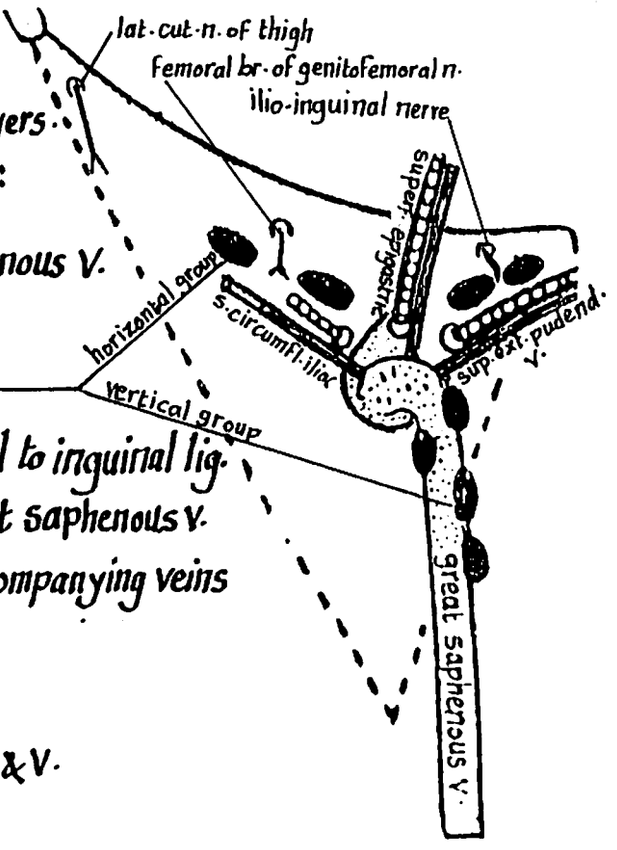
(A) **Superficial fascia of the roof:**

- it is formed of superficial fatty & deep membr. layers.
- the S. fascia contains the following structures:

(1) **One Vein**: the upper end of the great saphenous V. & its tributaries

(2) **Two groups** of superficial inguinal L. Ns:
 (a) horizontal group: below & parallel to inguinal lig.
 (b) vertical group: alongside the great saphenous V.

(3) **Three** superficial brs. of femoral a & their accompanying veins
 (a) superficial epigastric a. & V.
 (b) superficial circumflex a. & V.
 (c) superficial external pudendal a. & V.



(4) **Four** superficial nerves:
 (a) ant. br. of lat. cut. n. of thigh: at the upper lat. angle of femoral Δ
 (b) femoral br. of genito femoral n.: below the middle of the inguinal lig.
 (c) ilioinguinal n.: at the upper med. angle of femoral Δ.
 (d) intermediate cut. n. of thigh: at the apex of " ".

(B) **Deep Fascia of the roof**: it is the upper of fascia lata
it contains the Saphenous opening (see page 31)
(describe indetail).

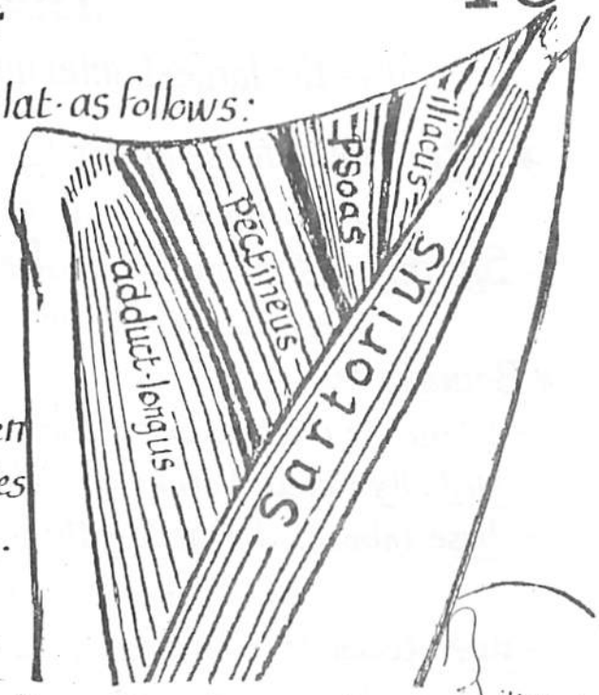
* Floor of the femoral triangle :

it is formed of 4 muscles arranged from med. to lat. as follows:

(1) adductor longus } slope laterally.
(2) pectineus m. }

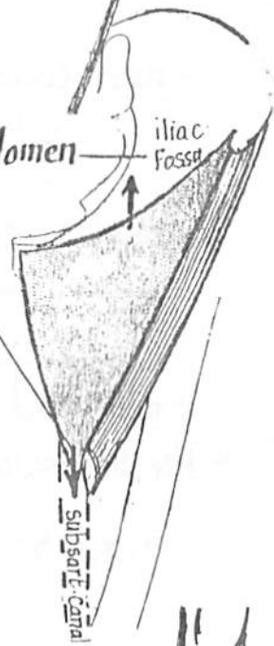
(3) Psoas major m. } slope medially.
(4) iliacus muscle }

N.B: A vertical gutter-like groove is formed between the 2 medial sloping & the 2 lateral sloping muscles. This groove lodges the contents of the femoral Δ.



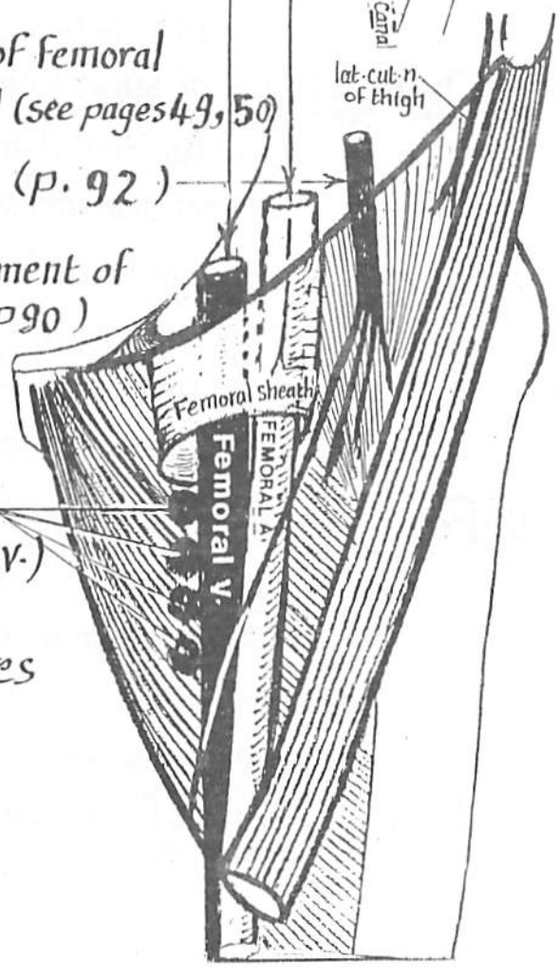
* Communications of the femoral triangle:

(1) Superiorly : it communicates, deep to the inguinal lig, with iliac fossa of abdomen
(2) inferiorly : it communicates, at the apex of the Δ, with the upper end of the subsartorial canal

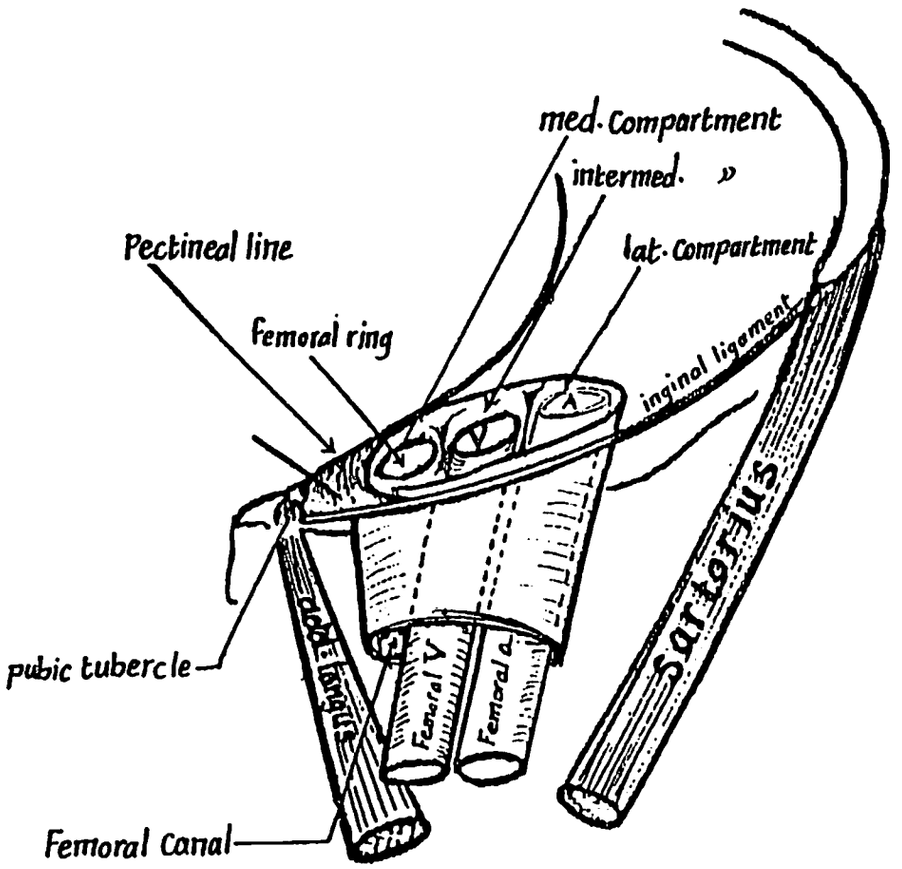


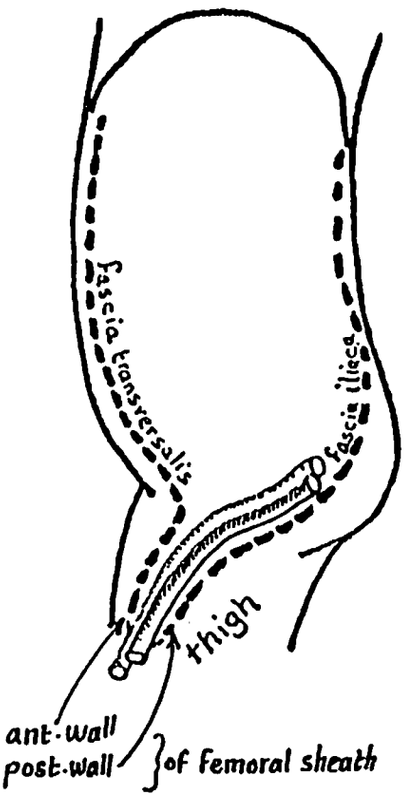
Contents of the femoral triangle

(1) Femoral artery & its branches (see p. 73).
(2) Femoral vein & its tributaries (see p. 87).
(3) Femoral Sheath : surrounding the upper 4 cm of femoral vessels & containing the femoral canal (see pages 49, 50)
(4) Femoral n. & its brs. : outside the femoral sheath (p. 92)
(5) Femoral br. of genitofemoral n. : in the lat. compartment of of the femoral sheath (p 90)
(6) Lat. cut. n. of thigh : in the upper lat. angle of the Δ. (p. 90)
(7) Deep group of inguinal Lymph Nodes : (1-3 nodes along the med. side of femoral V.)
(8) Collection of Fat in which the previous structures are embedded.



Comment on the Contents of femoral triangle





Femoral Sheath

* **Definition**: it is a fascial sheath surrounding the upper 4 cm of femoral vessels in the femoral triangle.
* **Shape & size**: it is funnel-shaped having ant. & post. walls, base, apex, med. & lat. margins:
 - the base: is directed upwards (continuous with the abdominal cavity behind the inguinal lig.).
 - the apex: is directed downwards & blends with the adventitia of femoral vessels
 - the lat. margin: is oblique & about 4 cm long.
 - the med. margin: is vertical & about 1½ cm long.

*Formation of the femoral sheath:

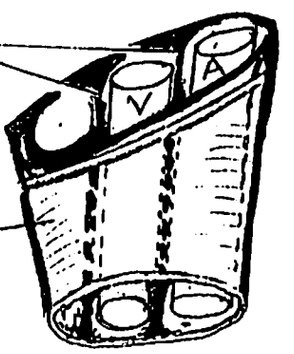
- the ant. wall: is a downward prolongation of fascia transversalis lining the ant. abd. wall.
- the post. wall: » » » » » fascia iliaca of the post. abdominal wall.

*Compartments of femoral sheath: 2 anteroposterior septa divide the sheath into 3 compartments:

(1) Lat. Compartment: Containing femoral a. & femoral br. of genitofem. n.

(2) Intermediate Compartment: Containing the femoral vein

(3) Medial Compartment: Called femoral canal: Containing fat & one lymph node



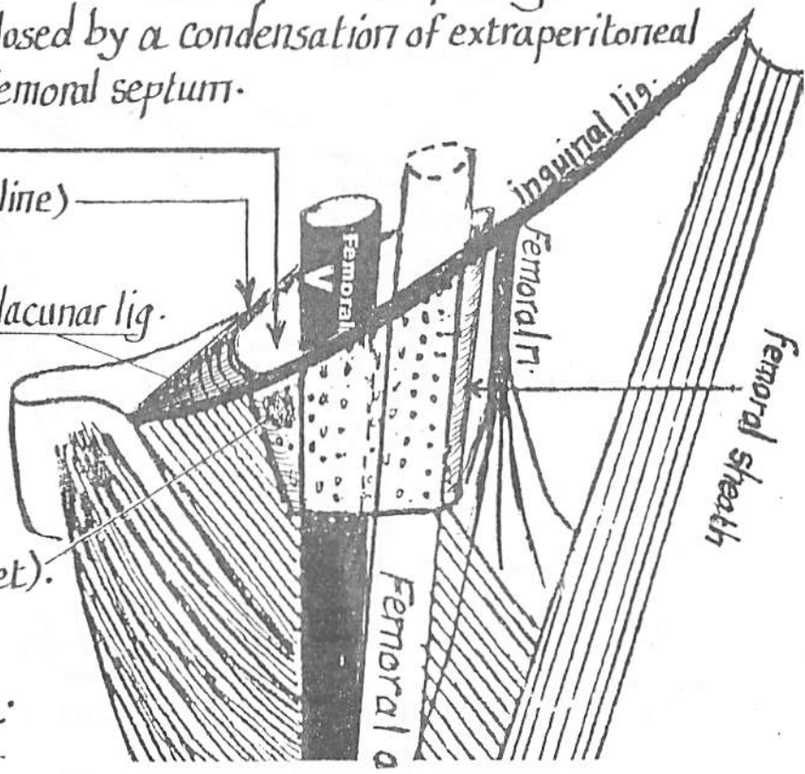
Femoral Canal

*Definition: it is the most med. compartment of the femoral sheath.

*Shape: it is conical vertical canal $1\frac{1}{2}$ cm long having:

(1) apex: directed downwards (blending with the adventitia of femoral V.

(2) base: called femoral ring: it is directed upwards, opening into the cavity & is normally closed by a condensation of extraperitoneal fatty tissue called the femoral septum.



*Boundaries of the femoral ring:

- posteriorly: pectineal lig. (along pectineal line)
- anteriorly: inguinal lig.
- medially: the sharp crescentic border of lacunar lig.
- laterally: femoral vein.

*Contents of the femoral canal:

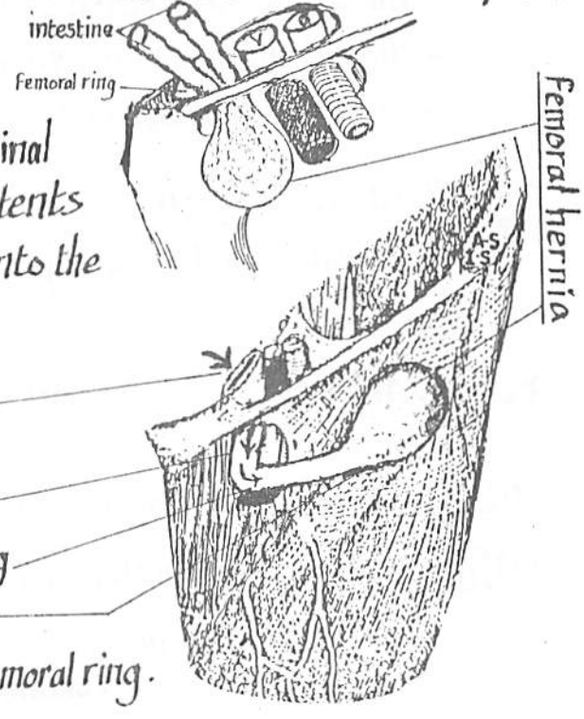
(1) Condensation of fat.
(2) lymph node of femoral canal (of Cloquet).
(3) lymphatic vessels.

*Functions of Femoral Canal:

(1) acts as a dead space alongside the femoral vein allowing its distension during increased venous return from the lower limb.
(2) it is the route for passage of lymphatics from the deep inguinal L.Ns to the abdominal L.N

N.B: femoral ring & femoral canal are wider in females than males (due to wider pelvis

*Applied anatomy: Femoral hernia:



- Femoral canal represents a weak area of the abdominal wall. It may allow the passage of some of the abd. contents (e.g loop of intestine) down through the femoral ring into the femoral canal. This is called Femoral Hernia.

- Course of descent of femoral hernia:

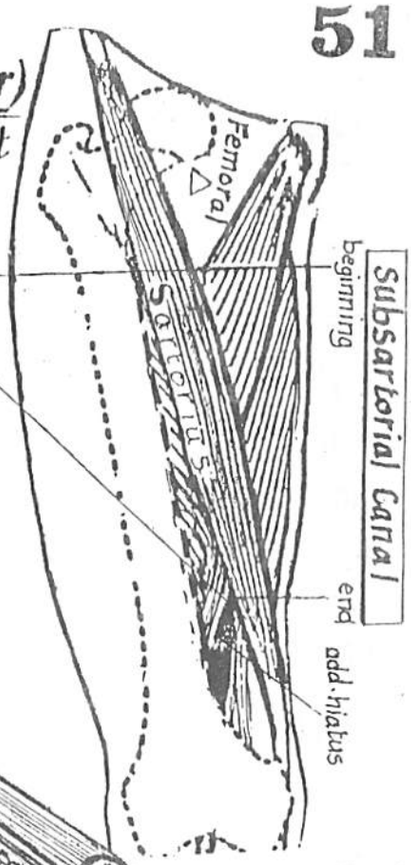
(1) it enters the femoral ring
(2) it passes downwards through the femoral canal
(3) " " forwards through the saphenous opening
(4) finally it passes upwards & laterally.

NB: femoral hernia is commoner in females due to wide femoral ring.

Adductor canal

(Subsartorial canal, canal of Hunter)

* **Site**: it is an intermuscular passage situated on the med. aspect of the middle 1/3 of the thigh undercover of sartorius m.
* **Beginning**: above, at the apex of the femoral triangle
* **End**: below, at the opening in adductor magnus (adductor hiatus). by becoming continuous with the popliteal fossa
* **Shape**: it is triangular in cross-section.



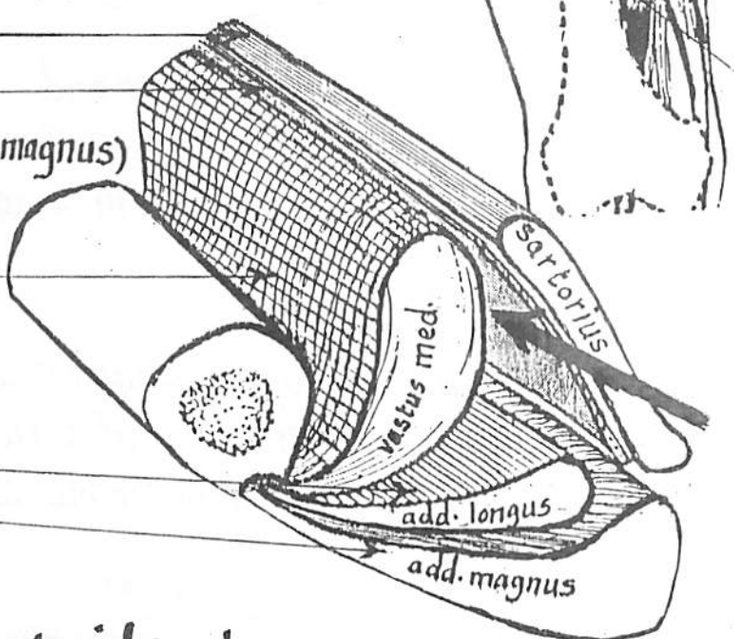
Subsartorial Canal

*Boundaries:

(A) **Anteromedial Wall (roof)** is formed of:
- (1) Sartorius m.
- (2) Strong sheet deep fascia (stretching between vastus medialis & add. magnus)

(B) **Anterolateral wall**: formed by vastus medialis m.

(C) **Posterior wall (floor)** formed of
- (1) add. longus m. : in the upper part
- (2) add. magnus m. : in the lower part



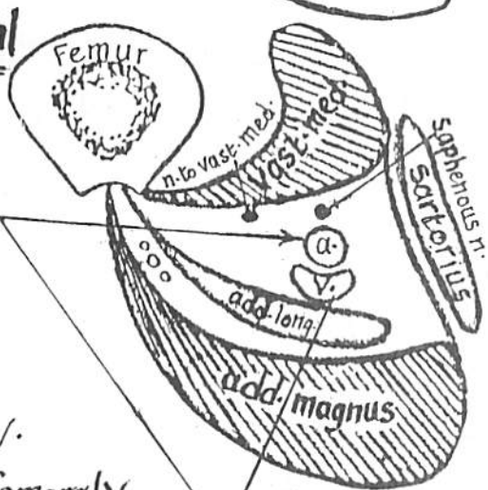
Boundaries of subsartorial C.

* Contents of Subsartorial Canal

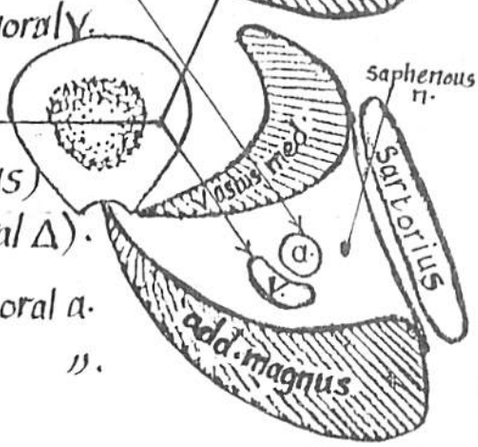
(3 vessels & 3 nerves)

(1) **Femoral artery**:
- enters the canal through its upper end.
- leaves " " " " lower end.
- Relations:
 - (a) in the upper part: it lies ant. to the femoral V.
 - (b) " " lower " : it lies anteromedial to the femoral V.

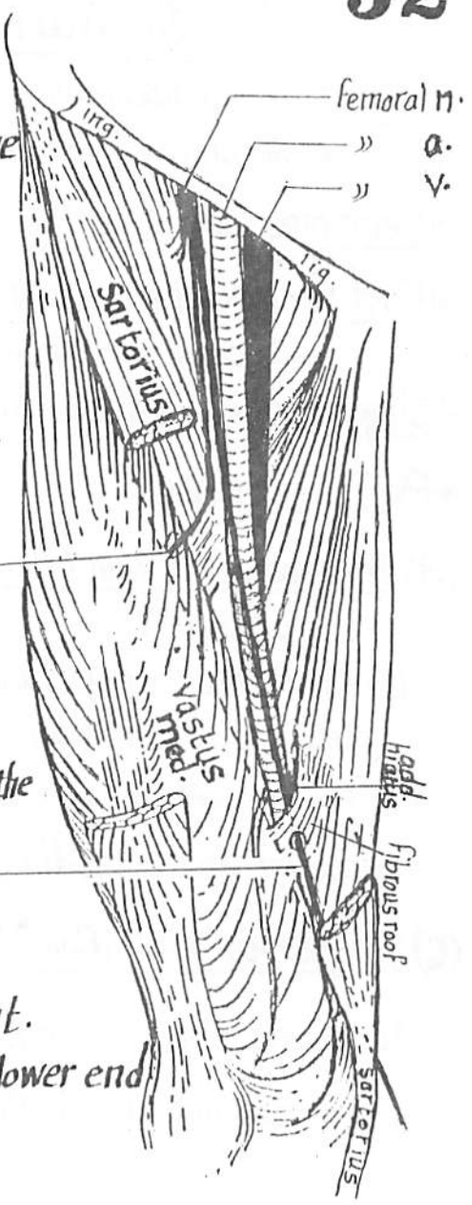
(2) **Femoral Vein**:
- enters the canal through its lower opening (add. hiatus)
- leaves " " " " upper end (apex of femoral Δ).
- Relations: (1) in the lower part: it lies posterolat. to femoral a.
 (2) " " V " : it lies posterior to " ".



T.S in the upper 1/2 of the canal



T.S in the lower 1/2 of the canal



(3) Descending genicular a.:

- arises as a branch of femoral a. in the lower part of the subsartorial canal.
- it leaves the canal by piercing the fibrous roof (not through its lower opening).
- it divides into:
 (a) superficial saphenous br.: accompanies the saphenous n.
 (b) deep muscular br.: enters vastus medialis & reaches the knee.

(4) N. to Vastus medialis:

- it enters the canal through its upper end.
- » descends lat. to the femoral a.
- it ends by entering vastus medialis in the upper part of the canal.

(5) Saphenous nerve:

- it enters the canal through its upper end.
- » crosses superficial to the femoral a. from med. to lat.
- » leaves the canal by piercing the fibrous roof above the lower end.

(6) Subsartorial plexus of nerves:

- it is a small plexus of nerves formed inside the canal by branches from:
 (a) saphenous n. (b) med. cut. n. of thigh (c) ant. division of obturator n.

N.B:

- 2 structures enter the upper end of the canal & leaves it through its lower e
 (a) femoral a. (b) femoral v.

- 2 structures enter the upper end & Do Not leave through its lower end:
 (a) saphenous n. (b) n. to vastus medialis

- 2 structures are formed within the canal:
 (a) descending genicular a. (b) subsartorial plexus of nerves.

Muscles of back of thigh (Hamstring muscles)

* General remarks :

(1) They are called hamstring muscles because their tendons form cords (strings) in the ham region (popliteal fossa & back of thigh).

(2) They include 3 muscles :
- (a) biceps femoris
- (b) semitendinosus
- (c) semimembranosus

(3) Origin : all arise from ischial tuberosity.

(4) Insertion : in the upper end of tibia & fibula.

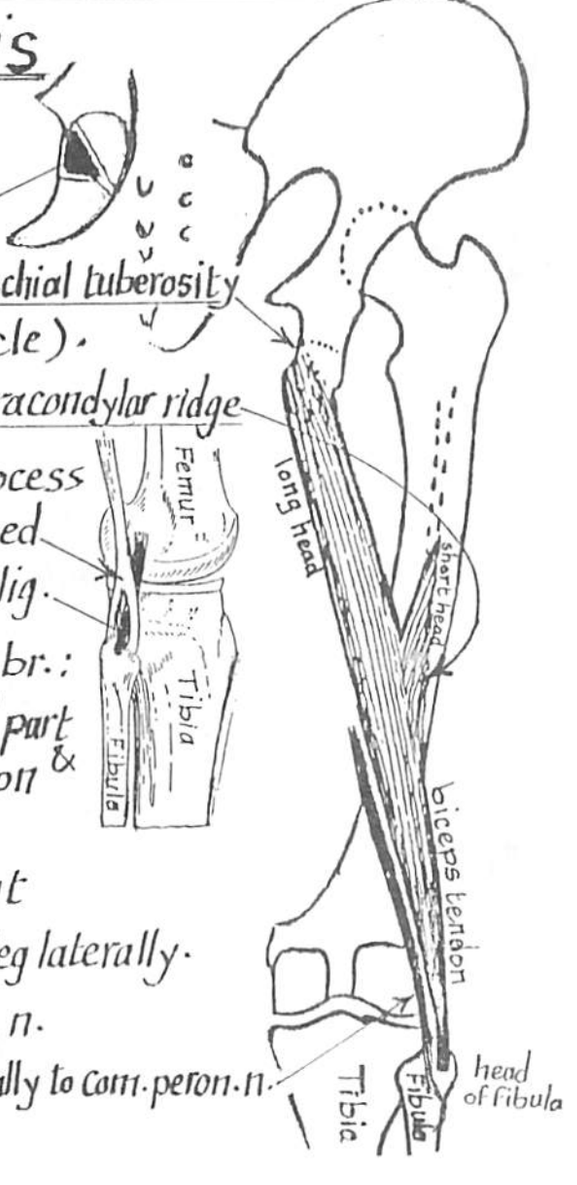
(5) N. Supply : sciatic n.

(6) Blood Supply : mainly from perforating brs. of profunda a.

(7) Action :
(a) all have a common action of extending the hip & flexing the knee
(b) the muscles inserted in the med. bone (tibia) which are semitendinosus & semimebranosus produce med. rotation of the leg.
(c) the muscle inserted in the lat. bone (fibula) produce lat. rotation of leg.



(1) Biceps Femoris



* It is the lat. hamstring m.

* Origin : by 2 heads :
(1) long head : from lower med. area of upper part of ischial tuberosity (in common with semitendinosus muscle).
(2) short head : from linea aspera + upper ½ of lat. supracondylar ridge

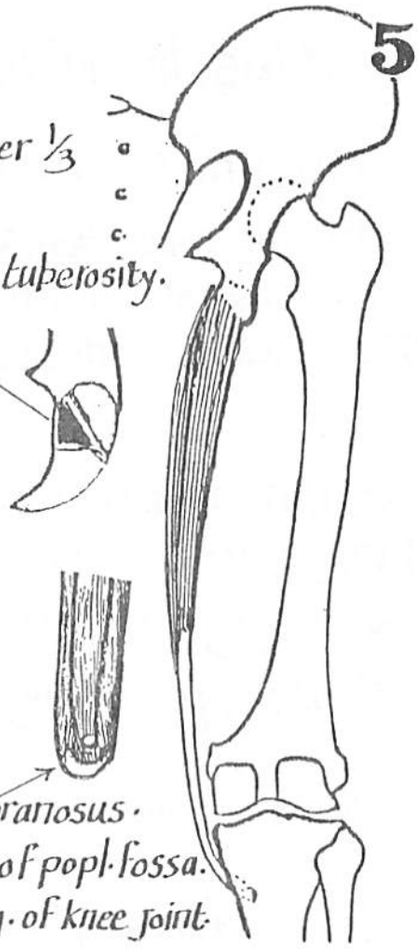
* Insertion : head of fibula infront of the styloid process
N.B : the tendon of insertion of biceps is splitted by or folded around the fibular collateral lig.

* N. Supply : Sciatic n. : each head has a separate br. :
N.B : (1) the long head is supplied by the tibial part &
(2) " short " " " " " common peroneal part of the sciatic n.

* Action : (1) long head : weak extensor of the hip joint
(2) short " : flexes the knee & rotates the leg laterally.

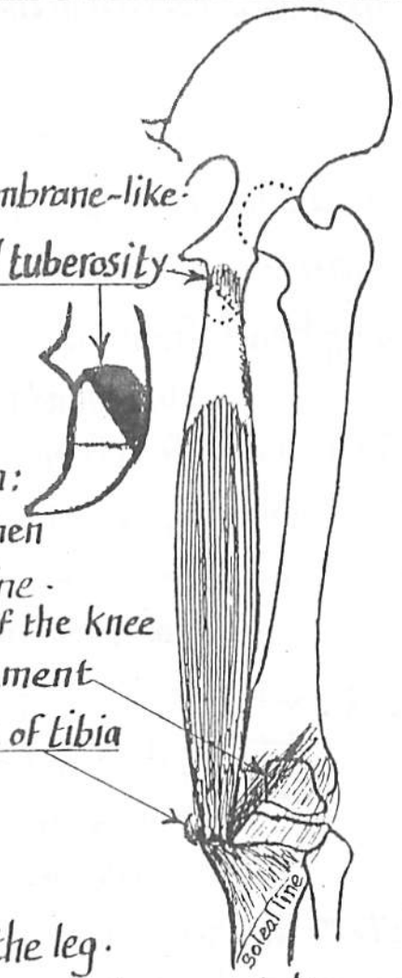
* Imp. relations : (1) the long head overlies the sciatic n.
(2) " tendon of insertion is related medially to com. peron. n.

(2) Semitendinosus m.



* It is a slender m. having a long tendon replacing its lower ⅓ (hence the name semitendinosus).
* **Origin**: from the lower med. area of upper part of ischial tuberosity. (in common with the long head of biceps).
* **Insertion**: upper part of med. surface of tibia (behind the insertion of gracilis)
* **N. supply**: sciatic n. (by 2 brs. from its tibial part).
* **Action**: (1) extension of hip joint
 (2) Flexion of knee & med. rotation of the leg.
 (3) it is one of the Guy ropes (S.G.S) which steady the pelvis on the femur
* **Imp. relations**:
 (1) it lies in a groove on the post. surface of semimembranosus.
 (2) its lower ⅓ shares in the formation of med. boundary of popl. fossa.
 (3) a deep bursa separates its tendon from the med. lig. of knee joint.

(3) Semimembranosus m.



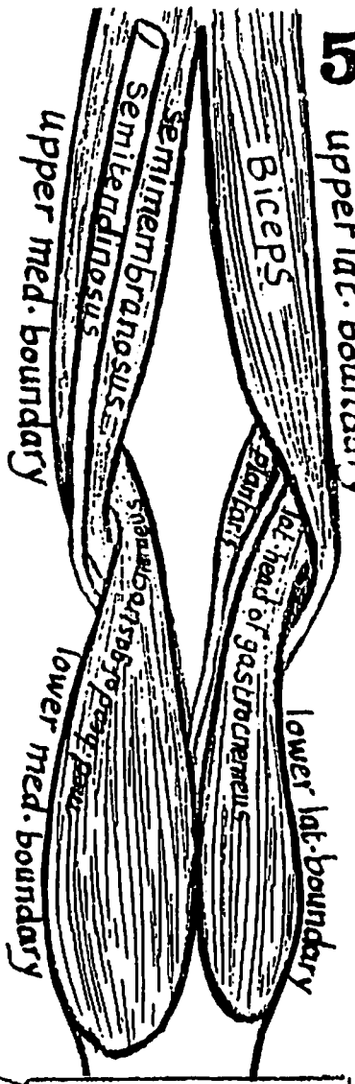
* It is the thickest m. of the hamstring group.
* it derives its name from the fact that its upper part is membrane-like.
* **Origin**: from the upper lat. area of upper part of ischial tuberosity
* **Insertion**:
 (1) By a flat tendon into the groove on the back of med. condyle of tibia
 (2) by 3 expansions (extensions) from the tendon of insertion:
 (a) extension passing downwards covering the popliteus m. then becomes attached to the soleal line.
 (b) " " upwards & laterally across the capsule of the knee forming the post. oblique popliteal ligament
 (c) " " forwards to the med. side of med. condyle of tibia
* **N. supply**: sciatic n. (from its tibial part).
* **Action**: (1) extension of the hip.
 (2) Flexion of the knee & med. rotation of the leg.
* **Imp. relations**: (1) its upper membrane-like tendon is sharp medially & rounded laterally
 (2) its lower ⅓ shares in formation of the med. boundary of popl. fossa
 (3) a bursa lies between its lower end & the med. head of gastrocnemius m.

Popliteal Fossa

* **Site**: it is an intermuscular space lying on the back of:
 (a) lower ⅓ of thigh.
 (b) knee joint.
 (c) upper part of leg.

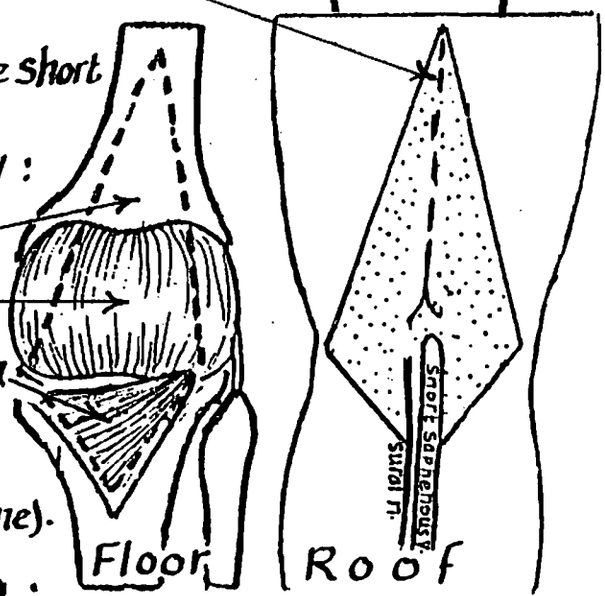
* **Shape**: diamond-shaped having 4 borders & 4 angles.

* **Boundaries**:
(1) upper lat. border: formed by biceps m.
(2) " med. " : formed by — semimembranosus, semitendinosus
(3) lower med. " : formed by med. head of gastrocnemeus
(4) " lat. " : formed by — lat. head of gastrocnemeus, plantaris m.



* **Roof**: formed of skin, superficial fascia & deep fascia.
(1) the superficial fascia contains:
 (a) lower part of post. cutaneous n. of the thigh
 (b) upper part of short saphenous vein.
(2) the deep fascia (popliteal fascia) is pierced by the short saphenous v.

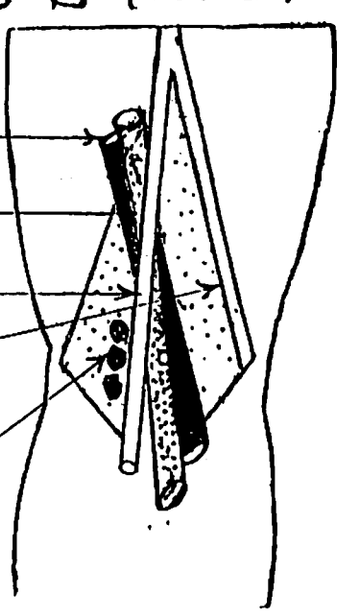
* **Floor**: is formed from above downwards by:
 (1) the popliteal surface of femur
 (2) back of capsule of knee joint
 (3) popliteus m. & its covering fascia



N.B: the popliteal fossa is limited below by the lower border of popliteus m. (the soleal line).

* Contents of the popliteal fossa:

(1) popliteal artery & its branches
(2) popliteal vein & its tributaries
(3) Tibial nerve & its branches
(4) Common peroneal nerve & its branches
(5) Popliteal lymph nodes
(6) variable amount of fat.



Comment on the Contents of popl. fossa

(1) **Tibial nerve** (med. popliteal n):
- enters the popliteal fossa through its upper angle
- descends vertically downwards crossing popliteal vessels superficially from lateral to medial.
- leaves the fossa at its lower angle (becoming post. tibial n.).
- gives muscular & articular brs. in addition to the sural n. which descends in the roof of the popliteal fossa (see p.98).

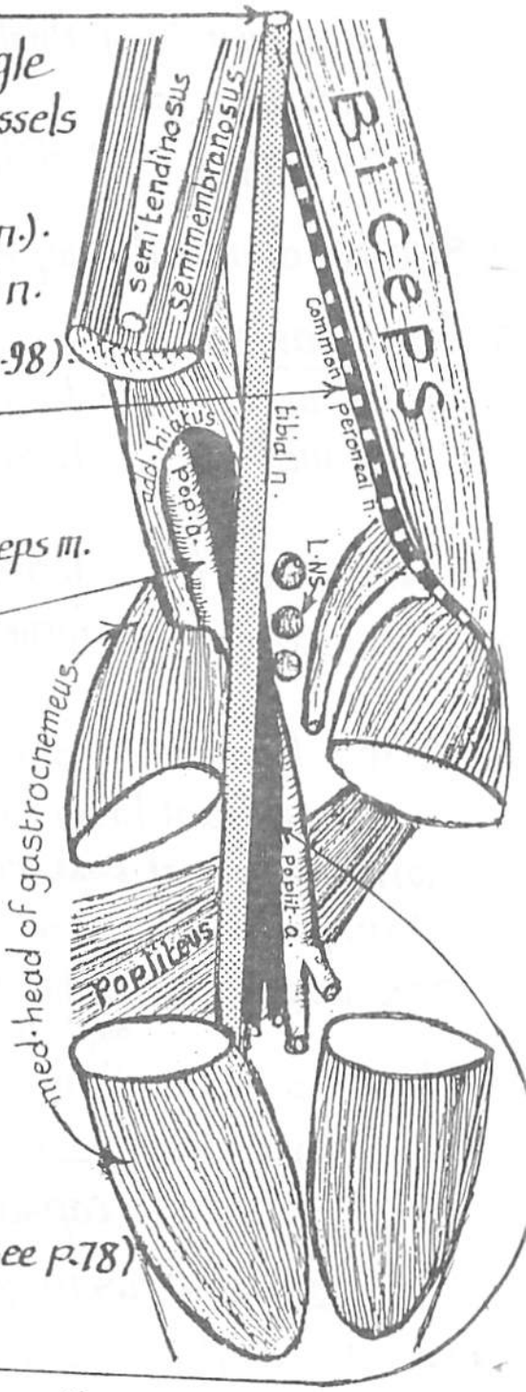
(2) **Common peroneal** (lat. popliteal) **nerve**:
- enters the fossa through its upper angle.
- descends downwards & laterally along med. side of biceps m.
- leaves the fossa through its lat. angle (see p.101).

(3) **Popliteal artery**:
- it is the deepest (most ant.) structure in the fossa
- it enters the fossa through the adductor hiatus as a continuation of the femoral a.
- descends on: (a) popliteal surface of femur
 (b) back of capsule of knee joint
 (c) fascia covering the popliteus m.
- ends: at the lower border of popliteus by dividing into ant. & post. tibial arteries
- branches in the fossa: (a) muscular (b) 5 genicular (see p.78)

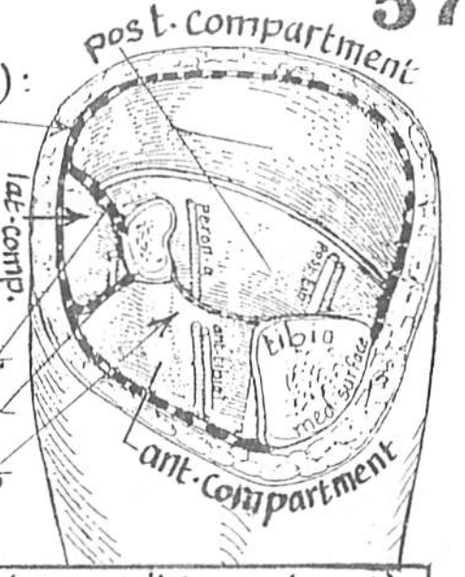
(4) **Popliteal Vein**:
- Begins (& enters the fossa) at the lower border of popliteus by the union of venae comitantes of ant. & post. tibial arteries.
- it ascends upwards crossing the popliteal a. from lateral (below) to medial (above)
- along its course it lies between tibial n. (superficially) & femoral a. (deeply).
- ends: by passing through the add. hiatus to become the femoral vein.
- tributaries: (a) Short saphenous v. (b) muscular veins (c) 5 genicular veins (see p 8

(5) **popliteal lymph nodes**:
- lie deep to the deep fascia, near the termination of the short saphenous V.
- receive afferent lymphatics from deep parts of the leg & drain into the deep inguinal L.N

(6) **Popliteal fat**: fills the spaces between the contents of the popliteal fossa



Compartments of the leg



* **Deep fascia of the leg or fascia cruris** (crus = leg):

- it is a strong tight membrane that surrounds the leg except the med. (subcutaneous) surface of tibia
- It forms 2 intermuscular septa:
 (1) post. intermuscular septum: attached to post. border of fibula
 (2) ant. » » » : » » ant. border of fibula
- These 2 septa, together with the interosseous membrane, divide the leg into 3 compartments; ant., post. & lat.:

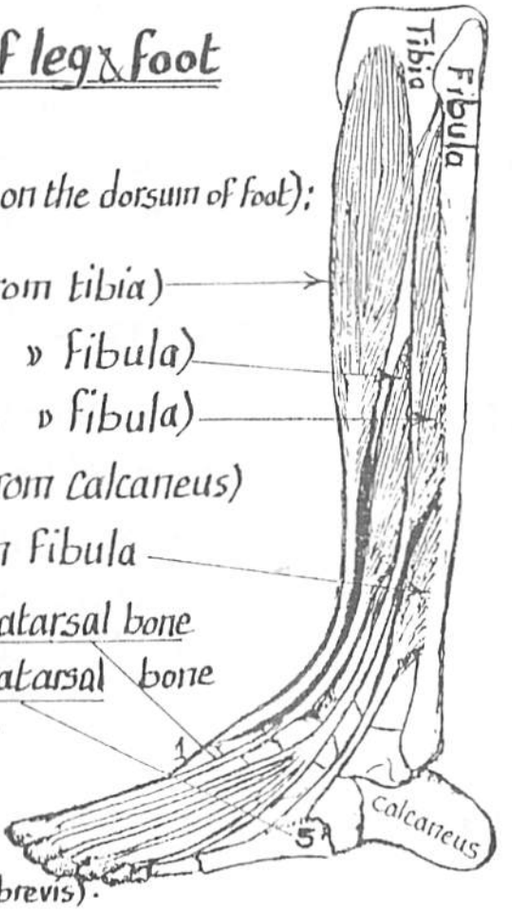
Ant. (extensor) Compartment	**Post.** (flexor) Compartment	**lat.** (peroneal) Compartment)
- lies infront of the interosseous memb., bounded medially by the tibia & laterally by the ant. septum	- lies behind the interosseous memb., bounded medially by the tibia & laterally by the post. septum	- lies lat. to the fibula & is bounded anteriorly by the ant. septum & posteriorly by the post. septum.
- it contains extensor muscles whose tendons pass infront of the ankle joint.	- it contains flexor muscles, divided by the transverse septum into superficial & deep groups whose tendons pass behind the ankle joint	- it contains evertor muscles whose tendons pass behind the lat. malleolus.
it is supplied by ant. tibial vess. & n. (deep peroneal n.)	- supplied by post. tibial n. & vessels	- Supplied by superficial peroneal n. - (no vessels pass in the lat. comp.

Anterior Compartment of leg & foot

General remarks:

* They include 5 muscles (4 of ant. comp. of leg & 1 on the dorsum of foot):

* **Origin**:
 (1) Tibialis ant. (arise from tibia)
 (2) Ext. hallucis longus (» » fibula)
 (3) Ext. digitorum » (» » fibula)
 (4) Ext. » brevis (from calcaneus)
 (5) peroneus tertius (from fibula



* **Insertion**:
 - 1st muscle: in the base of 1st metatarsal bone
 - 5th » : » » » » 5th metatarsal bone
 - the remaining muscles pass to the toes as indicated by their names
* **N. Supply**: all are supplied by ant. tibial n.
* **Action**:- all are dorsiflexors of ankle (except ext. dig. brevis).
 - each muscle has a special action (indicated by its name).

(1) Tibialis anterior m



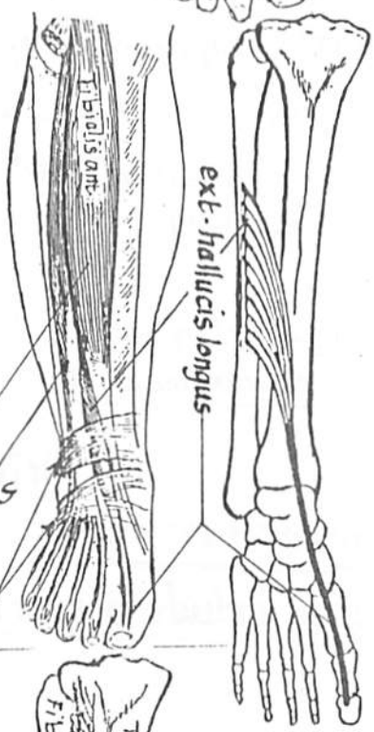
*Origin: - upper 2/3 of lat. surface of shaft of tibia.
- adjoing part of the interosseous membrane.
- intermuscular septum between it & ext. digit. longus.

*Insertion: the muscles ends in a tendon which passes deep to the sup. & inf. extensor extensor retinacula to be inserted into:
(1) med. side of the med. cuniform.
(2) adjoining part of base of the 1st metatarsal bone.

*N. Supply: - ant. tibial n.

*Action: (1) Dorsiflexion of ant. (when the foot is off the ground).
(2) inversion of the foot (» » » » on the ground).
(3) helps to maintain the med. longitudinal arch of the foot.

(2) Extensor Hallucis longus



*Origin: - middle 2/4 of ant. surface of fibula.
- adjoining part of the interosseous membrane.

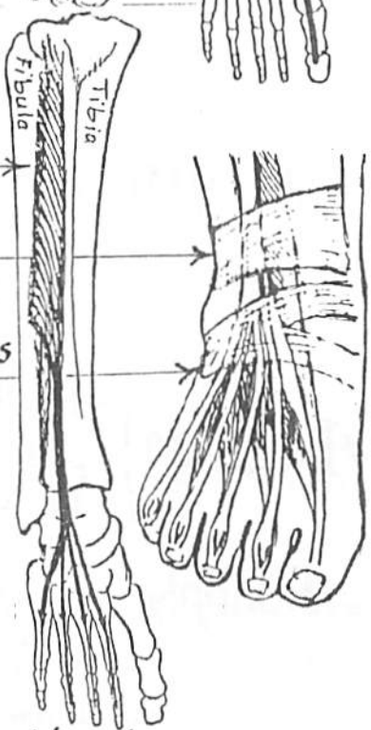
*Insertion: base of terminal phalanx of the big toe.

*N. Supply: ant. tibial n.

*Action: (1) extension of all joints of the big toe.
(2) dorsiflexion of the ankle joint.

*Imp. relations:
(1) at its origin, the muscle lies deep under cover of tibialis ant. & ext. digit. longus
(2) in the lower part, its tendon emerges between the previous 2 muscles & descends behind the sup. & inf. extensor retinaculae

(3) Extensor digitorum longus



*origin: (1) upper 3/4 of ant. surface of fibula.
(2) adjoining part of the interosseous membrane

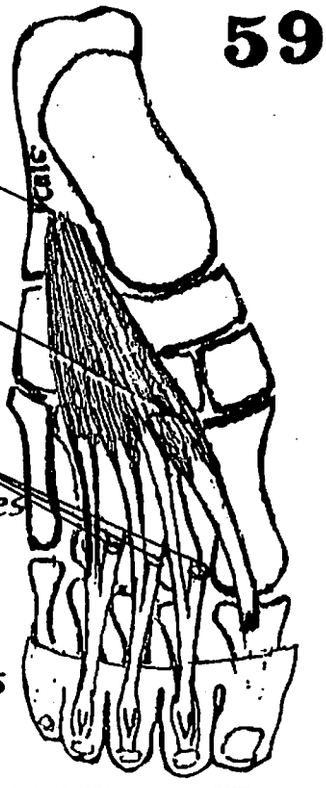
*Course: - its tendon passes deep to the sup. ext. retinaculum then divides under cover of the inf. ext. retinaculum into 4 tendons passing to the lat. 4 toes
- each tendon is joined on its lat. side by a tendon of ext. digit. brevis forming dorsal digital expansion

*Insertion: each expansion divides into 3 slips:
- middle: inserted into base of middle phalanx
- 2 collaterals: » » » » terminal phalanx

*N. Supply: ant. tibial n.

*Action: (1) extension of joints of lat. 4 toes (2) dorsiflexion of ankle joint.

(4) Extensor Digitorum Brevis



* **Origin**: ant. part of the upper (dorsal) surface of calcaneus
* **Insertion**: - the muscle breaks into 4 slips for the med. 4 toes
 (the most med. slip is called extensor hallucis brevis
 - the ext. hallucis brevis is inserted into base of proximal phalanx of the big toe.
 - the remaining 3 tendons join the lat. side of the tendons ext. digit. longus (dorsal digital expansions) for 2nd, 3rd & 4th toes
* **N. Supply**: ant. tibial n. (by its lat. terminal br.).
* **Action**: (1) Ext. hall. brevis: extends proximal phalanx of big toe.
 (2) the other 3 tendons: extend middle & terminal phalanges of 2-4 toes (particularly in dorsiflexed foot).

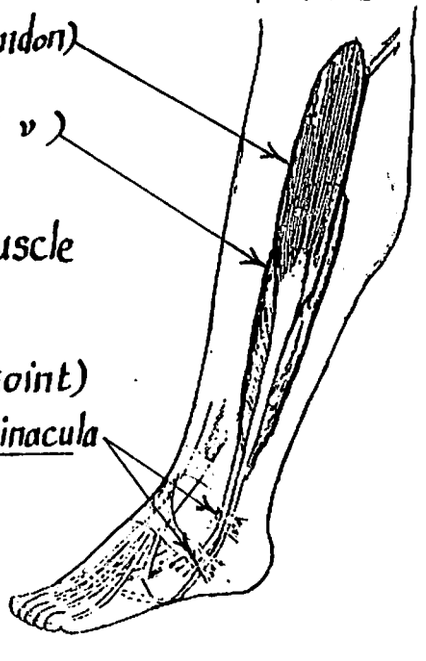
(5) Peroneus tertius m. (may be absent)

it may be regarded as part of ext. digit. longus (formig its 5th tendon)



* **Origin**: (1) lower ¼ of ant. surface of fibula
 (2) adjoining part of the interosseous memb.
 (3) ant. intermuscular septum
* **Insertion**: (1) dorsal aspect of base of 5th metacarpal bone
 (2) by triangular expansion into med. side of shaft of 5th metatarsal bone.
* **N. Supply**: ant. tibial n.
* **Action**: (1) dorsiflexion of ankle joint (2) Eversion of foot.

Lat. Compartment of the leg (peroneal muscles)



* **General remarks**:
 it contains 2 muscles
 (1) peroneus longus (having longer tendon)
 (2) peroneus brevis (» shorter »)

N.B: (a) peroneus means related to fibula (perone bone).
(b) peroneus tertius (of ant. comp.) means the 3rd peroneal muscle

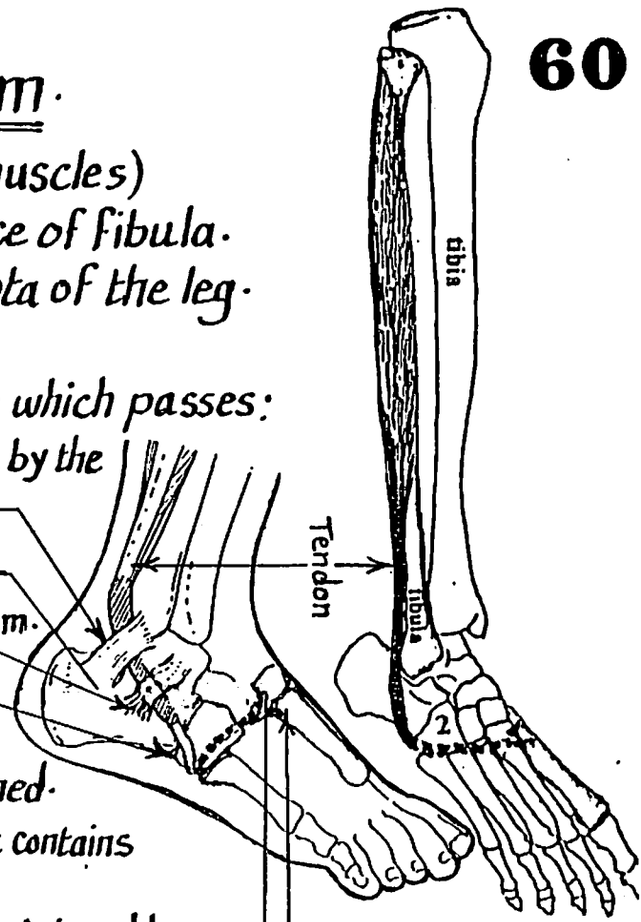
* **Origin**: From the lat. surface of the fibula
 Their tendons pass behind the lat. malleolus (i.e behind ankle joint) & are held in position by the sup. & inf. peroneal retinacula
* **N. Supply**: superficial peroneal (musculocutaneous) n.
* **Action**: planter flexion & eversion of foot.

1- Peroneus longus m.

(The superficial of the 2 lat. peroneal muscles)

*Origin : (1) head & upper 2/3 of lat. surface of fibula.
(2) ant. & post. intermuscular septa of the leg.
(3) deep fascia of the leg.

*Course: the muscle ends in a long tendon which passes:
(1) behind the lat. malleolus where it is held in place by the superior peroneal retinaculum
(2) then it runs across the lat. surface of calcaneus where it is held in place by the inf. peroneal retinaculum.
(3) it crosses the lat. side of the cuboid bone then the groove on its under surface.
(4) it crosses the sole (in the 4th layer) from lat. to med. & is kept in place by the long plantar lig. & it contains sesamoid bone as it passes below the cuboid bone.



*Insertion: (1) lat. side of base of 1st. metatarsal bone
(2) lat. " " the medial cuniform bone

*N. Supply : Musculocutaneous (superficial peroneal) n.

*Action: (1) plantar flexion of ankle joint.
(2) eversion of the foot (when the foot is off the ground).
(3) maintains the lat. longitudinal & transverse arches of foot.

2- Peroneus Brevis m.

*Origin: (1) lower 2/3 of lat. surface of shaft of fibula.
(2) ant. & post. intermuscular septa of the leg.
(3) deep fascia of the leg.

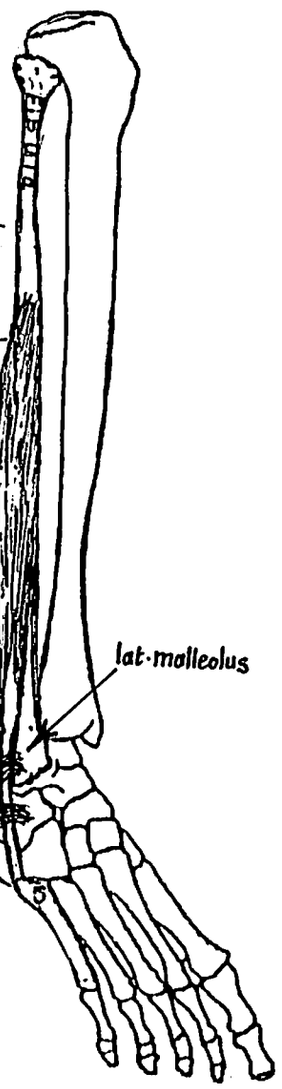
*Course: the muscle ends in a tendon which passes behind the lateral malleolus then on the lat. surface of calcaneous being held in position by the sup. & inf. peroneal retinaculae.

*Insertion : tuberosity of the 5th metatarsal bone.

*N. Supply: Musculocutaneous (superficial peroneal) n.

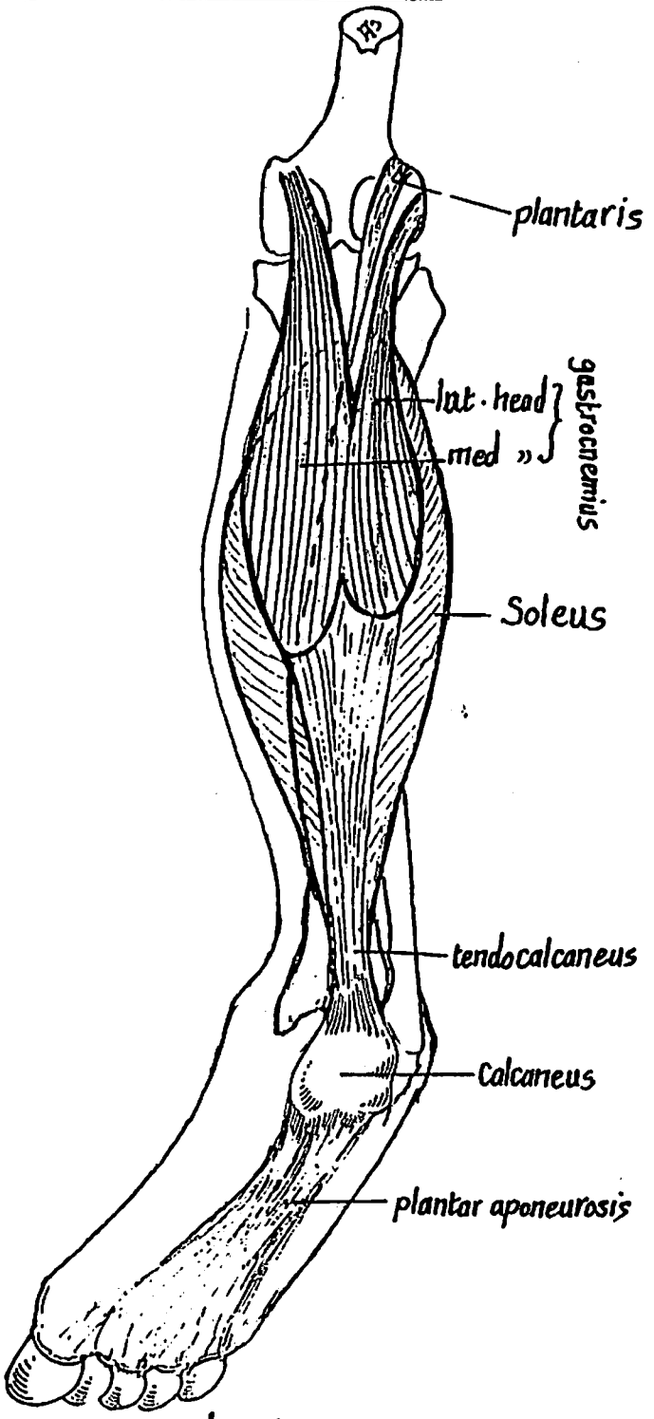
*Action : (1) eversion of the foot (when it is off the ground).
(2) plantar flexion of ankle

N.B: eversion & inversion do not occur in the ankle joint but take place in the subtalar & talocalcaneo-navicular joints.



Muscles of the back of the leg

superficial group

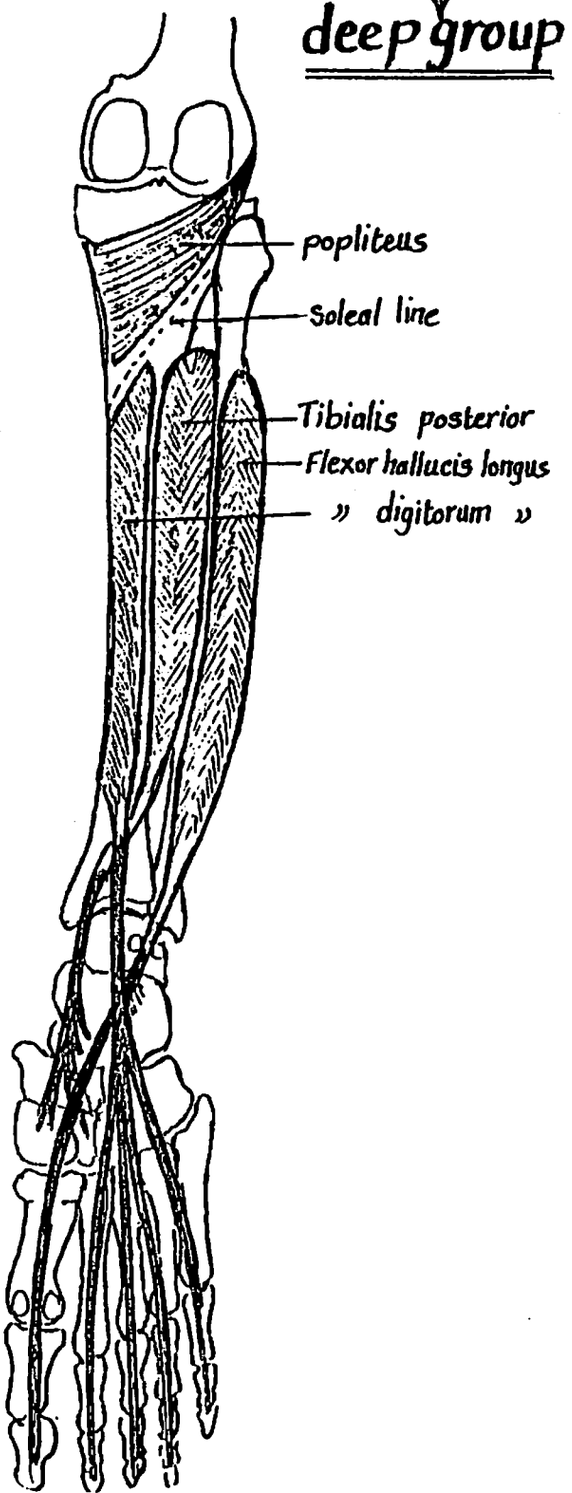


* They include the following 3 muscles:

(1) Gastrocnemius (= twin bellies) m.
(2) Soleus m. (shaped like sole of a boot).
(3) plantaris m. (inbetween the previous 2).

+ all of them are inserted into Calcaneus by the tendoCalcaneus (the thickest & strongest tendon in the body).

deep group



* They include the following 4 muscles

(1) popliteus.
(2) Flexor digitorum longus.
(3) Flexor hallucis longus.
(4) Tibialis post.

(1) Gastrocnemius m.

It is a strong m. which arises by 2 heads & crosses 2 joints (knee & ankle).

* **Origin**: by 2 heads:
 - (1) lat. head: arises from a rough impression on the lat. surface of lat. condyle of femur above lat. epicondyle
 - (2) med. head: popliteal surface of femur above med. condyle

N.B: (a) the med. head is larger & more fleshy than the lateral
(b) the lat. head usually contains a sesamoid bone called **Fabella** opposite the lat. condyle of femur.
(c) the med. condyle is separated from the capsule of knee J. by bursa.

* **Course**:- the 2 heads are separated in the upper ½ of leg by a furrow which contains 2 structures: **S**hort saphenous V. & **S**ural n.
 - the 2 heads unite near the middle of leg forming tendocalcaneus

* **Insertion**: by tendocalcaneus into the middle ⅓ of post. surface of Calcaneus

N.B: tendocalcaneous (Achilis) is the thickest & stongest tendon in the body. & is about 15 cm long.
- its ant. surface receives fleshy fibres of soleus m. almost down to the lower end.
- a bursa separates the tendon from upper part of post. surface of Calcaneus.

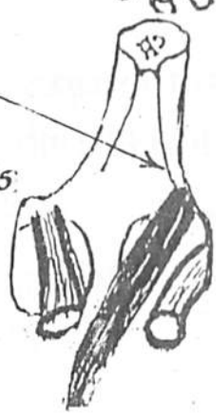
* **N. Supply**: med. popliteal (tibial) n.: each head receives separate br.

* **Action**: (1) a powerful plantar flexor of ankle.
 (2) helps flexion of the knee (with hamstrings).
 (3) antigravity m. acting with soleus (see P. 63).



(2) Plantaris

* it is a rudimentary muscle in man & may be absent (as palmaris longus)
* it has a short belly & a long thin tendon.
* **Origin**: (1) lower part of lat. supracondylar ridge of femur
 (2) From the oblique popliteal lig.
* **Course**:- the muscle belly lies just med. to lat. head of gastrocnemeus.
 - the muscle develops a very long tendon which lies between gastrocnemius & soleus, crossing from lat. to medial.

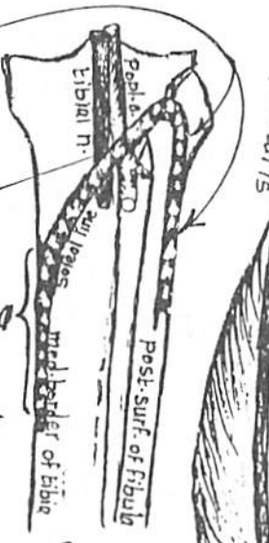


* **Insertion** :- either in the tendocalcaneus,
 - or separately into post. surface of calcaneus.
* **N. Supply** : tibial (med. popliteal) n.
* **Action** : it is a rudimentary m. (accessory to gastrocnemeus).

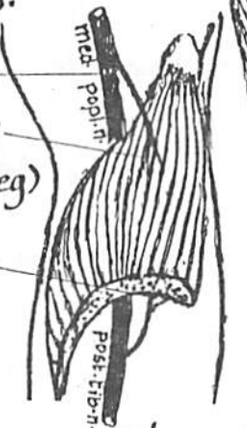
3- Soleus muscle

It is sole-shaped multipennate m. lying deep to gastrocnemeus.

* **Origin**: horse-shoe shaped origin from:
 (1) upper 1/3 of post. surface of **fibula** + back of its head.
 (2) strong **fibrous arch** between tibia & fibula which overlies tibial n. & popliteal a
 (3) **Soleal line** & middle 1/3 of med. border of tibia



* **Insertion**: into the deep surface of the tendocalcaneus which is inserted into the middle 1/3 of post. surface of calcaneus.
* **N. supply**: (1) med. popliteal (tibial) nerve: by branch to its superficial surface
 (2) post. tibial n. (in the middle of the leg) by br. to its deep surface.

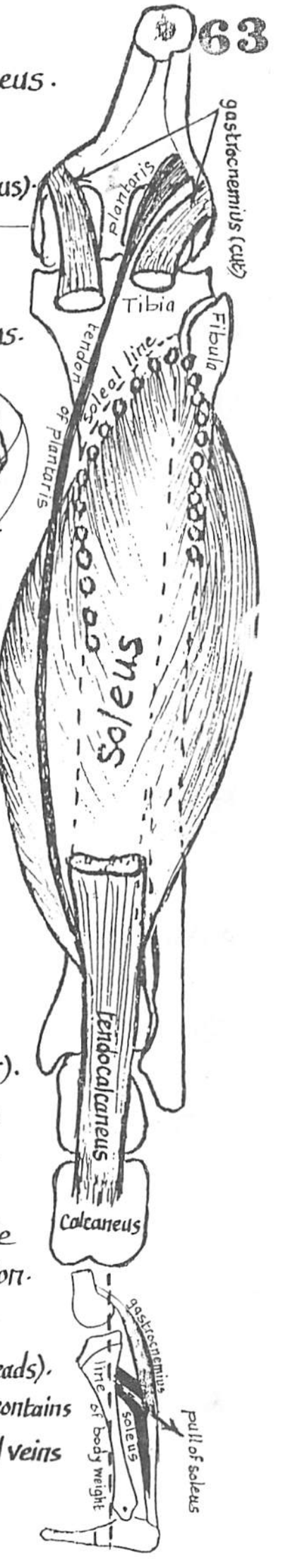


* **Action**:

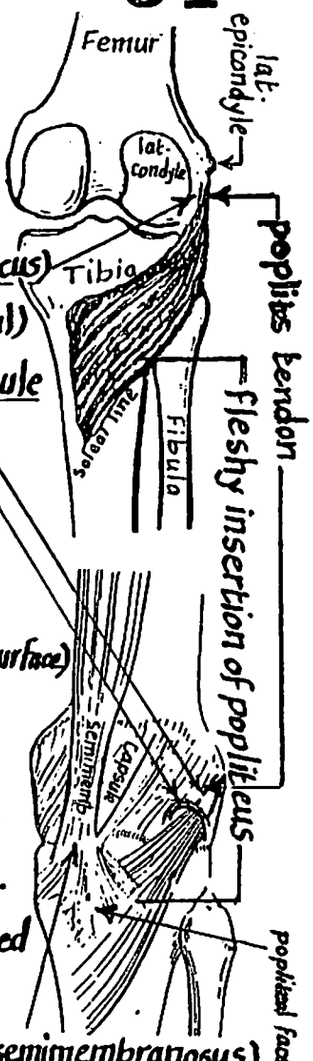
(1) It is a powerflexor of the foot:
it has a very strong but slow action (like the 1st gear of the car). When movement is under way, the quicker acting gastrocnemius increases the speed (like the top gear of the car) e.g in running.

(2) it is a strong antigravity muscle:
it counteracts the tendency of body weight to fall infront of ankle by pulling the leg backwards, thus maintains the standing position.

N.B: (1) the 2 heads of gastrocnemius + the soleus are called the Triceps surae muscle (as they form muscular mass having 3 heads).
(2) soleus is called **peripheral venous heart** because it contains a rich venous plexus which drains blood from the superficial veins (tributaries of saphenous veins) & pumps it to the deep veins.



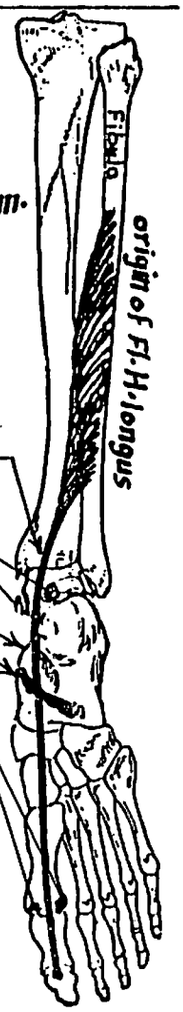
(4) Popliteus muscle



* It is a flat triangular m. forming the lower part of the floor of the popliteal fossa.
* **Origin**: by a strong rounded tendon from the ant. part of the groove on the lat. surface of lat. condyle of femur (popliteal sulcus) lying below the lat. epicondyle (intracapsular extrasynovial)
* **Course**: the tendon emerges through a perforation on the back of the capsule below the arcuate popliteal ligament
* **Insertion**: Fleshy, into the med. 2/3 of the triangular area above the soleal line on the post. surface of tibia
* **N. supply**: tibial n. while in the popliteal fossa (by a br. which hooks around the lower border of popliteus to reach its ant. surface)
* **Action**: (1) weak flexor of the knee joint.
 (2) **unlocking** of knee joint: by rotating the femur laterally (when the tibia is fixed) or rotating the tibia medially (when it is movable), during the initial stage of flexion of the knee.
 (3) it retracts the lat. meniscus, protecting it from being crushed between the condyles of femur & tibia (see knee joint).

N.B: the muscle is covered by a thick popiteal fascia (extension from tendon of semimembranosus)

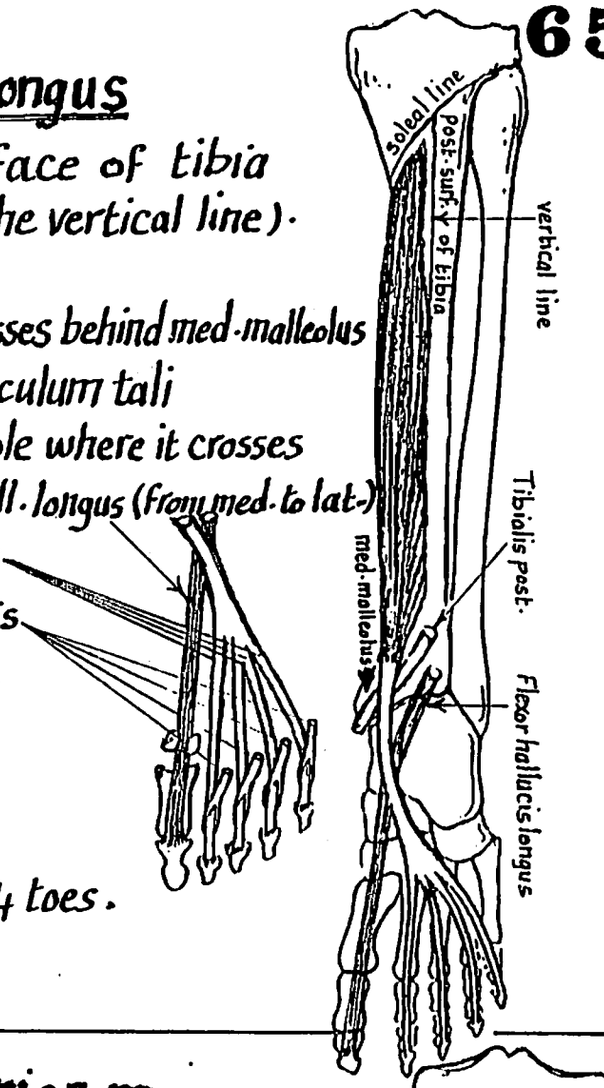
(5) Flexor Hallucis Longus



* **Origin**: (1) lower 2/3 of post. surface of fibula (below the origin of soleus m.)
 (2) lower part of » » » interosseous memb. & post. intermusc. septum.
* **Insertion**: base of terminal phalanx of big toe.
* **N. Supply**: post. tibial n.
* **Course**: its tendon has a special course (using 3 bony areas as pulleys):
 (1) it lies in a shallow groove on the back of the lower end of tibia
 (2) then » » a deep groove on the back of talus (between 2 tubercles)
 (3) » » in a groove on the undersurface of the sustentaculum tali
 (4) it runs in the 2nd layer of the sole, crossed by tendon of Fl. digit. longus
 (5) Finally it passes between 2 sesamoid bones below the head of the 1st metatarsal bone
* **Action**: (1) Flexion of all joints of the big toe.
 (2) assists in planter flexion of the foot.
 (3) supports the med. longitudinal arch of the foot.

(6) Flexor Digitorm longus

* **Origin**: upper 2/3 of med. part of post. surface of tibia (below the soleal line & medial to the vertical line).
* **Course:**
 (1) its tendon crosses that of tibialis post. then passes behind med. malleolus
 (2) it runs along the free margin of the sustentaculum tali
 (3) then it runs forwards in the 2nd layer of the sole where it crosses superficial to (below) the tendon of flex. hall. longus (from med. to lat.)
 (4) near the toes, it divides into 4 smaller tendons which perforate the tendons of flexor digitorm brevis
* **Insertion**: bases of terminal phalanges of the lat. 4 toes.
* **N. Supply**: post. tibial n.
* **Action**: (1) flexion of all joints of the lat. 4 toes.
 (2) plantar flexion of foot.

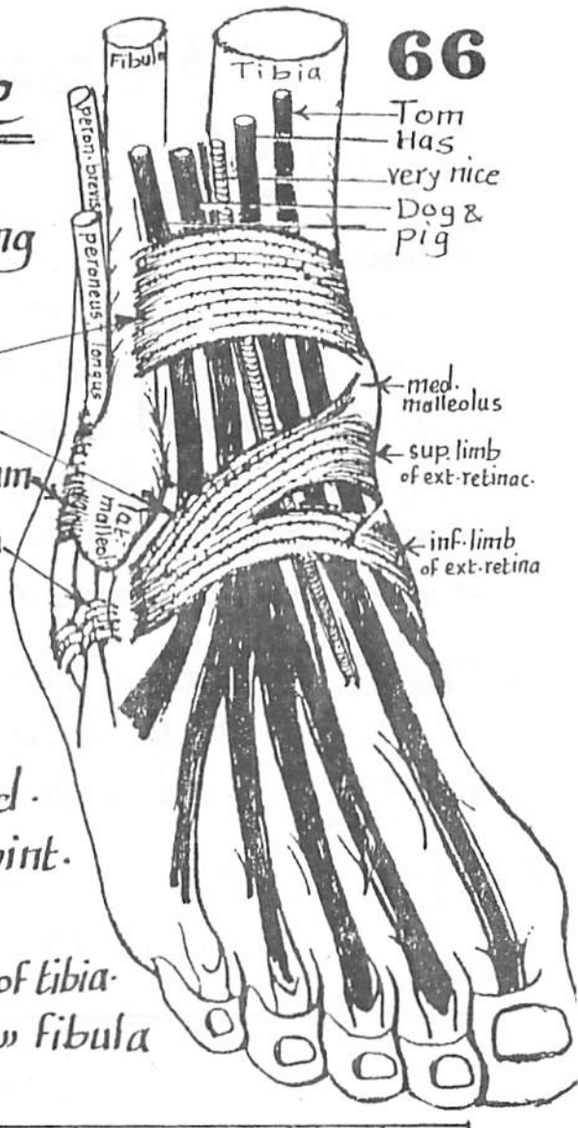


(7) Tibialis posterior m.

* It is a fusiform bipennate m. that lies deepmost in the post. compartment.
* **Origin**: (1) post. surface of the interosseous membrane
 (2) upper 2/3 of post. surface of tibia lateral to the vertical line
 (3) upper 2/3 of post. surface of fibula (infront of the med. crest).
 (4) intermuscular septa of the back of leg.
* **Course:**
 (1) its tendon is crossed superficially by that of Fl. digit. longus in the lower 1/4 of leg.
 (2) " " lies in a groove on the back of the med. malleolus
 (3) " " enters the foot deep to the flexor retinaculum (above sustentaculum tali).
* **Insertion**: its tendon divides into 2 parts:
 (a) med. part (main insertion): inserted into the tuberosity of navicular bone
 (b) lat. part inserted into: (1) all tarsal bones except the talus
 (2) bases of 2nd, 3rd & 4th metatarsal bones
* **N. Supply**: post. tibial n.
* **Action**: (1) inversion of the foot (with tibialis anterior)
 (2) plantar flexion of foot.
 (3) maintains the med. longitudinal arch of the foot.



Retinaculae of the ankle



* They are thickene bands of deep fascia which surround the ankle joint & retain the tendons passing to the foot in position. They include

- 2 extensor retinacula
 - sup. ext. retinaculum
 - inf. ext. retinaculum
- 2 peroneal retinacula
 - sup. peroneal retinaculum
 - inf. peroneal retinaculum
- one flexor retinaculum.

(1) Sup. extensor retinaculum

* **Shape**: thick transverse band of deep fascia 1 inch broad.
* **Site**: lower part of leg, immediately above ankle joint.
* **Attachents**:
 (1) medially: to the lower one inch of ant. border of tibia.
 (2) laterally: " " " " " " " " fibula
* **Relations**:

Structures passing deep to it (arranged from med. to lat.)	Structures passing superficial to it (arranged from med. to lat.)
(1) Tom : Tibialis anterior (2) Has : Ext. Hallucis longus (3) Very : ant. tibial Vessels (4) Nice : " " Nerve (5) Dog : ext. Digitorum longus (6) & Pig : Peroneus tertius	(1) beginning of the great saphenous vein (2) lower part of saphenous n. (3) branches of musculocutaneous n.

(2) Inferior extensor retinaculum

* **Shape**: Y-shaped band of deep fascia having a stem & 2 limbs: sup. & inf.
* **Site**: infront of ankle, below the sup. ext. retinaculum (more important than it).
* **Attachments**:
 (a) the stem of the Y: is attached to the ant. part of the upper surface of calcaneus.
 (b) the upper band of the Y: attached to the ant. margin of the med. malleolus.
 (c) " lower " " " ": attached to the deep fascia of the med. side of the foot.
* **Structures passing superficial to it**: as in sup. extensor retinaculum
* " " **deep** " ": " " " " " (except that the vessels are dorsalis pedis instead of ant. tibial).

*Synovial sheaths of extensor tendons:

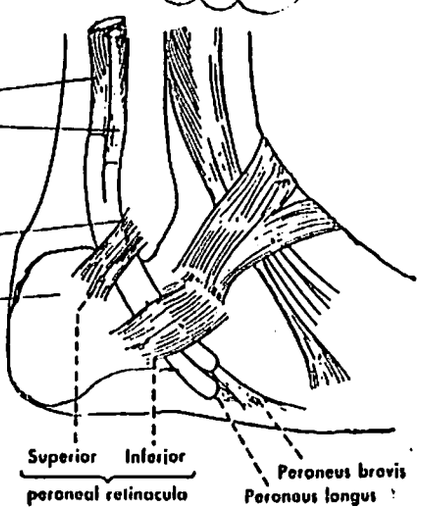


(1) Synovial sheath for tibialis anterior tendon:
extends from the upper margin of the sup. extensor retinaculum to the interval between the 2 diverging limbs of the inf. ext. retincalum.

(2) Common sheath for ext. digitorum & peroneus tertius tendons:
starts just above the level of the 2 malleoli down to the level of the base of 5th metatarsal bone.

(3) Synovial sheath for extensor hallucis longus tendon:
starts below that of ext. digitorum & extends to the base of 1st metatarsal b.

3- Superior peroneal retinaculum



*Site: lies over peroneus longus & brevis tendons as they pass behind the lat. malleolus.

*Attachments: - above: to the back of the lat. malleolus
- below: to the lat. surface of calcaneus

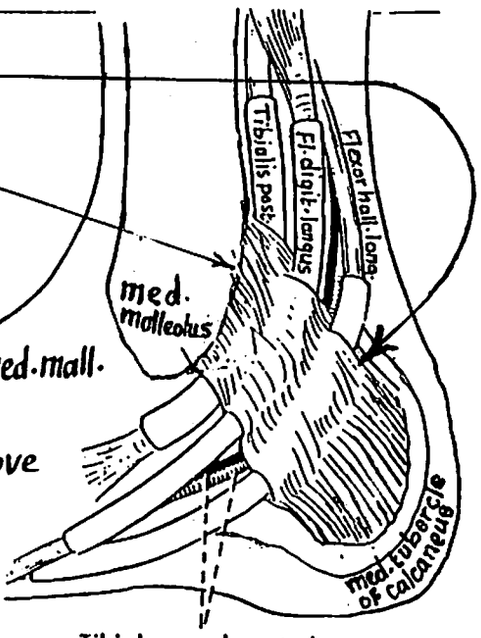
4- Inferior peroneal retinaculum

*Site: it brides over the 2 peroneal tendons (longus & brevis) as they reach the lat. surface of Calcaneus.

*Attachments: it is attached by its 2 ends to the lat. surface of the calcaneus where it is continuous above with the stem of the inf. extensor retinaculum.

*Synovial sheath of the 2 peroneal tendons: begins as a single sheath proximally but becomes double distally, till 4 cm below tip of the lat. malleolus

5- Flexor Retinaculum



*Site: below & behind the med. malleolus

*Attachments: above: to the post. border of med. malleolus
below: to the med. tubercle of calcaneus.

*Structures passing deep to it (From med. to lat.):

(1) Tom: Tibialis post. (its synovial sheath starts 4 cm above the med. mall. & ends just proximal to navicular bone).

(2) Does: Flexor Digitorum longus (its synovial sheath starts just above med. mall. & extends to the navicular bone.

(3) Very: post. tibial Vessels (divides into med. & lat. plantar vess.)

(4) Nice: " " Nerve (" " " " " " nerves

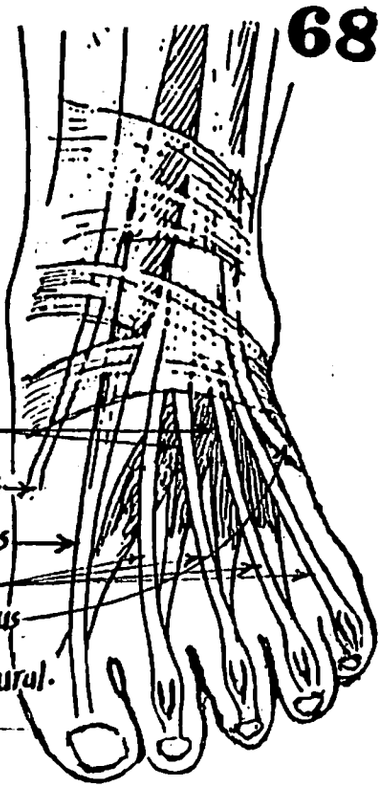
(5) Hats: Flexor Hallucis longus (its synovial sheath extends from the med. mall. to the base of the 1st metatarsal bone).

The Foot

* Functions:

(1) provides a rigid support for the body weight in standing.
(2) acts as a movable spring-like structure in walking.

Dorsum of the foot

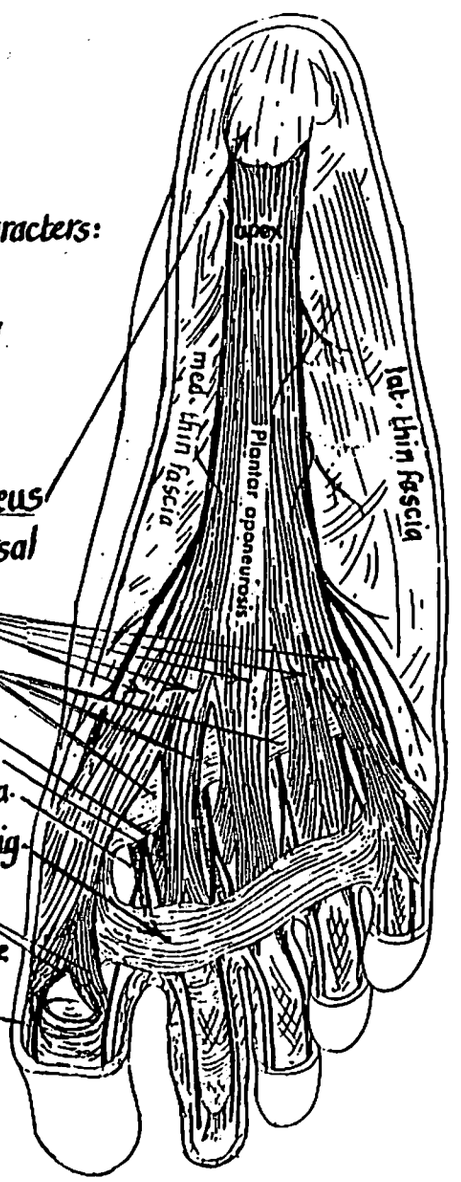


* Contains:

(A) One muscle (which has no homologue in the hand): ext. digit. brevis
(B) tendons of the extensor compartment of the leg
(C) Vessels: dorsalis pedis a. (P. 81) / dorsal venous arch (P. 85)
(D) Nerves: terminations of
(1) deep peroneal (2) superficial peroneal (3) saphenous (4) sural.

Sole of the foot

plantar aponeurosis



* It is the deep fascia of the sole.
* It is formed of central thick part & med. & lat. thin parts.

(A) The central part covers Fl. digit. brevis m. & has the following characters:

- Shape: triangular in shape having an apex directed posteriorly towards the heel & base directed anteriorly towards the heads of the metatarsal bones.

- Attachments:

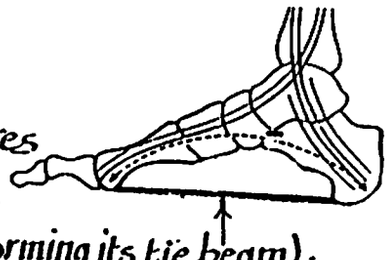
(1) its Apex (narrow post. end): is attached to med. tubercle of calcaneus
(2) its base (broad ant. end): divides near the heads of metatarsal bones into 5 slips (one for each toe)
- these slips are connected by transverse fascial bands
- the space between each 2 slips contains: (a) lumbrical m. (b) plantar digital n. (c) plantar metatarsal a.
- near the toes, the slips are crossed by the superficial transv. metatar. lig.
- finally each slip divides opposite the M.P. joint into 2 parts which blend with the fibrous flexor sheath of the corresponding toe.

(3) the med. & lat. margins of the central part send med. & lat. septum respectively, which extend deeply into the sole, on each side of flexor digitorm brevis muscle.

(B) The lateral thin part covers abductor digiti minimi muscle.

(C) The medial " " " abductor hallucis m. & is continuous proximally with the Fl. retinac.

* Functions of the plantar aponeurosis:



(1) fixes the skin of the sole & protects the deeper structures
(2) gives origin to the muscles of the 1st layer of the sole
(3) helps in maintaining the longitudinal arches of the foot (forming its tie beam).

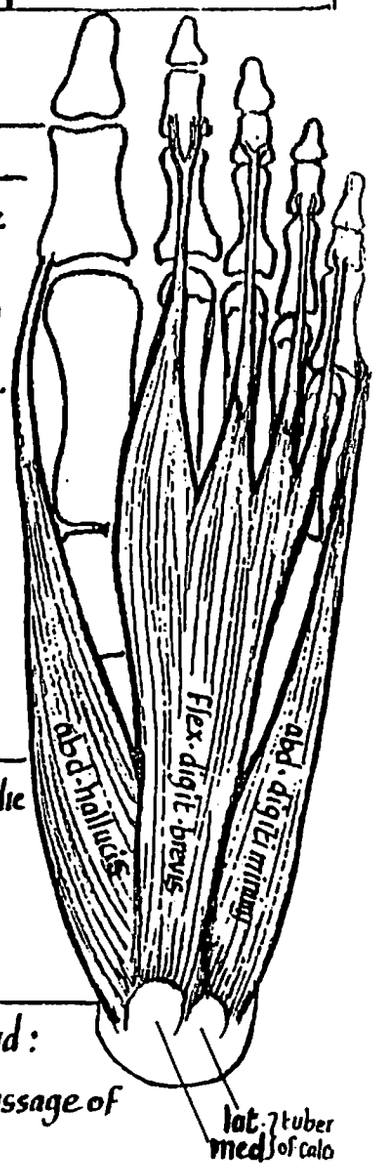
Layers of the sole

The muscles & tendons of the sole are arranged in 4 layers, separated by layers of fascia in which plantar vessels & nerves lie.

First layer	second layer	third layer	fourth layer
Contains 3 muscles	2 muscles & 2 tendons	3 muscles	2 muscles & 2 tendons
(1) Abductor hallucis (2) Abd. digiti minimi (3) Flexor digitorum brevis	- Four lumbrical muscles - Flexor accessorius m	- adductor hallucis m. - Flexor hallucis brevis - Flex. digiti minimi brevis	- plantar interossei - dorsal interossei
	• Fl. hall. longus tendon • Fl. digit. " "		• peroneus longus tendon • tibialis post. tendon

1- The First layer of the sole

M.	origin	Insertion	nerve supply	Action
(1) Abd. hallucis	(1) med. tubercle of calc. (2) flexor retinaculum. (3) plantar aponeurosis.	by a strong tendon into the med. side of base of the proximal phalanx of the big toe	Medial plantar nerve	(1) abducts big toe (2) maintains the med. longitudinal arch of the foot.
Flex. digit. brevis	(1) med. tubercle of calc. (2) plantar aponeurosis	• divides into 4 tendons for the lat. 4 toes. • each tendon is inserted into the sides of the base of the middle phalanx		(1) Flexion of the lat. 4 toes
Abd. digiti minimi	(1) med. & lat. tubercles of calcaneus. (2) plantar aponeurosis.	• lat. side of base of the proximal phalanx of the little toe.	lat. plantar n.	(1) abduction of the little toe



N.B: the tendons of Flex. digit. brevis resemble Flex. digit. superficialis of the hand: each tendon divides into 2 slips which decussate to form a tunnel for the passage of the Flexor digit. longus tendon

II- The Second layer of the Sole

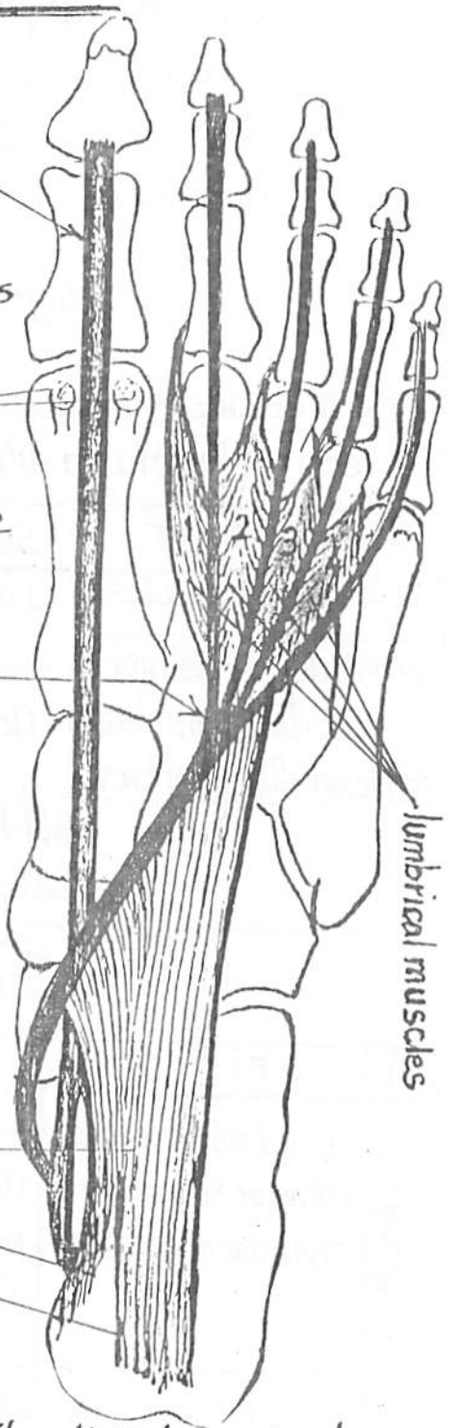
(A) 2 tendons:

(1) Tendon of Flexor hallucis longus:

- passes deep to the tendon of Flexor digitorum longus
- at the point of crossing, it gives a slip to the Fl. digit. longus
- then it passes forwards grooving the lower surface of the flexor hallucis brevis then between 2 sesamoid bones present in the tendons of that muscle.
- finally, it is inserted into the plantar surface of the base of the distal phalanx of the hallux.

(2) Tendon of Flexor digitorum longus:

- Crosses superficial to the tendon of Flexor hallucis longus
- it divides into 4 slips passing to their insertion in the bases of terminal phalanges of the lat. 4 toes.
- to reach their insertion, they perforate the tendons of Flexor digitorum brevis



(B) 2 Types of Muscles:

(1) Flexor accessorius muscle

- Origin: med. head: from med. surface of calcaneus
 lat. head: " inf. surface of calcaneus
- Insertion: lat. margin of tendon of Flexor digitorum longus.
- N. supply: lat. plantar n.
- Action: it corrects (straightens) the oblique line of pull of Flex. digit. longus tendon

(2) Four lumbrical muscles:

- Origin: the 1st is unipennate arising from the Fl. digit. longus tendon of the 2nd toe.
 " 2nd, 3rd & 4th are bipennate, arising from the adjacent sides of the tendons of Fl. digit. longus to the 3rd, 4th & 5th toes.
- Insertion: they pass upwards across the med. side of the M.P. joints to blend with the extensor expansions on the dorsum of the lat. 4 toes.
- N. Supply: - the 1st (medial) lumbrical is supplied by the med. plantar n.
 - " 2nd, 3rd & 4th " are " " " lat. plantar n.
- Action: Flexion of the M.P. & extension of the I.P. joints of the lat. 4 toes.

III- Third layer of the Sole

- It contains 3 muscles (2 flexors & one adductor):

(1) Flexor Hallucis brevis (F.H.B):

* Origin: plantar surface of cuboid & lat. cuniform bones.
* Insertion: the muscle splits into 2 tendons (med. & lat.) which are inserted into both sides of base of the proximal phalanx of big toe.

N.B: each tendon contains a sesamoid bone

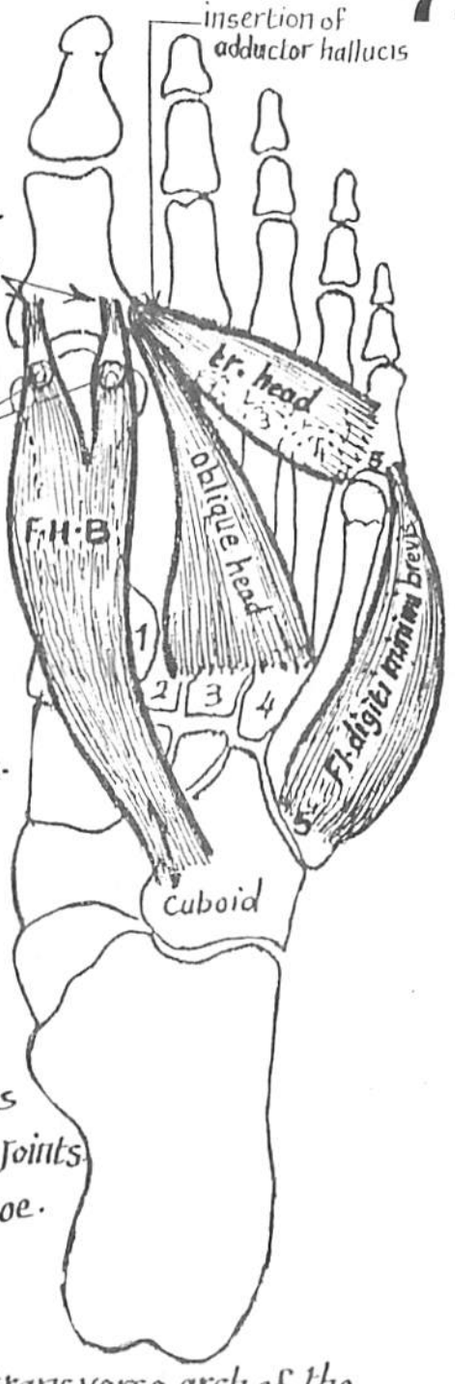
* N. supply: lat. plantar n.
* Action: flexes the M.P joint of the big toe.

(2) Flexor Digiti minimi Brevis

* Origin: med. side of base of 5th metatarsal bone
* Insertion: lat. side of base of proximal phalax of little toe.
* N. supply: lat. plantar n.
* Action: flexes the M.P. joint of the little toe.

(3) Adductor Hallucis:

* Origin: by 2 heads
 (a) oblique head: from bases of 2nd, 3rd & 4th metatarsal bones
 (b) transverse " : from capsules & ligaments of the lat. 4 M.P. joints
* Insertion: lat. side of base of proximal phalanx of big toe.
* N. supply: lat. plantar n.
* Action: (1) the oblique head: adducts the big toe
 (2) " transverse head: helps to maintain the transverse arch of the foot by drawing the roots of the toes closer.

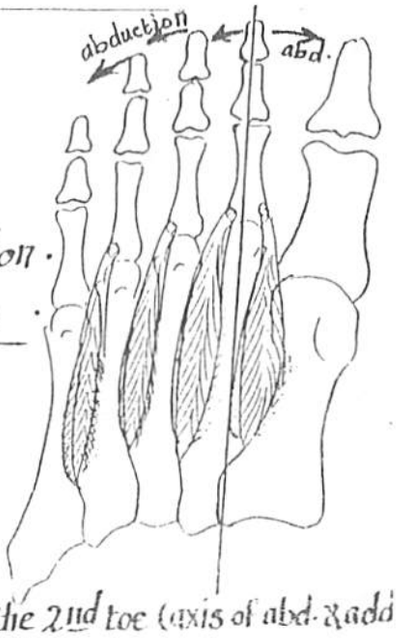


IV- Fourth layer of the Sole

Contains:

(A) 2 types of muscles < Dorsal interossei.
plantar " .

(B) 2 tendons < peroneus longus tendon.
tibialis posterior " .



(1) Dorsal interossei: are 4 in number & are bipennate

* Origin: from adjacent sides of metatarsal bones
* Insertion: bases of proximal phalanges & extensor expansions of the respective toes (2nd 3rd & 4th)
* N. supply: lat. plantar n.
* Action: adduct the 2nd, 3rd & 4th toes towards the middle line of the 2nd toe (axis of abd. & add

(2) Plantar interossei : are 3 in number & unipennate

*Origin: shafts of the 3rd, 4th & 5th metatarsal bones.
*Insertion : extensor expansion & base of the corresponding toe.
*N. supply : lat. plantar n.
*Action: adduct the 3rd, 4th & 5th toes towards the middle line of the middle toe (axis of the foot).

(3) Tendon of peroneus longus

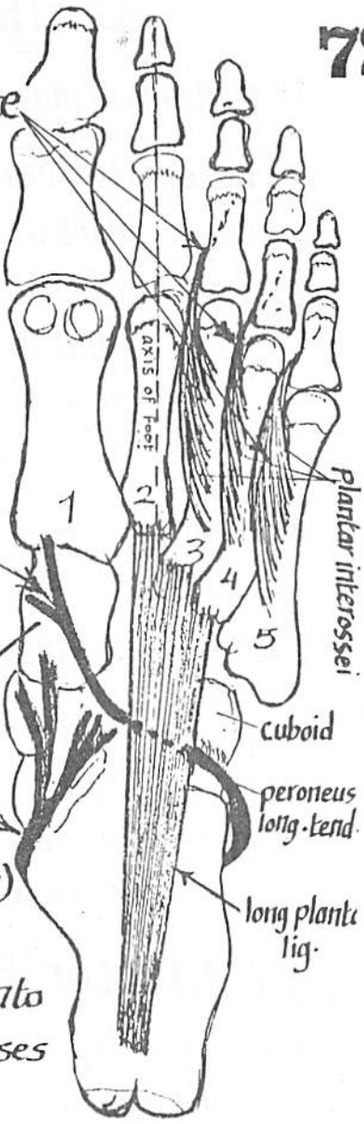
- runs obliquely across the foot in the groove of cuboid bone, undercover of the long plantar lig.
- inserted into base of 1st metatarsal & adjoing part of med. cuniform

(4) Tibialis posterior tendon :

it divides into :

(a) large med. part: inserted into the tuberasity of naviculer (mainly) & med. cuniform (partly)

(b) small lat. part : divides into many slips which are inserted into the other tarsal bones (except talus) & into the bases of the 2nd, 3rd & 4th metatarsal bones.



* General remarks about N. supply of the Sole

(1) Medial plantar n. (like median n. in the hand) : supplies

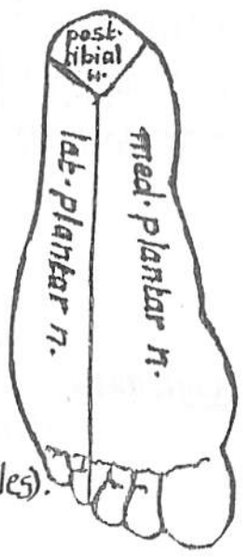
(a) few muscles (4)
- (1) Abd. H. ابدوة : Abd. Hallucis m.
- (2) F. H. B فهب : Flex. Hallucis brevis
- (3) F. D. B فدب : Flex. Digit. brevis
- (4) 1st lumb قلبي : First lumbrical

(b) large skin area : med. 2/3 of sole + med. 3½ toes

(2) Lateral plantar n. (like ulnar n. in the hand) : supplies :

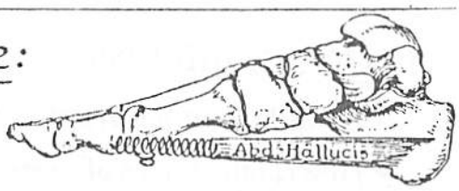
(a) many muscles : all the remaining muscles of the sole (14 muscles).

(b) small skin area : lat. ⅓ of sole + lat. 1½ toes.



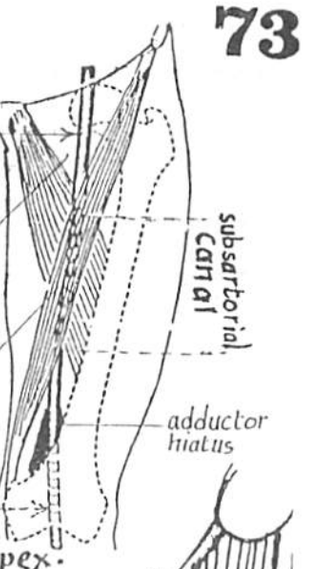
* General remarks about Action of muscles of the Sole :

(1) their tone helps to maintain the arches of the foot.
(2) they steady the toes particularly when the foot is on the ground (i.e under load).
(3) they have specific actions (indicated by their names)



Arterial Supply of L.L.

1- Femoral artery



*__Origin__ : begins behind the midinguinal point as a continuation of the external iliac a.

*__Course__ : - its upper ½ lies superficial in the femoral triangle
- its lower ½ lies deep in the subsartorial (adductor) canal.

*__Termination__ : at the junction of upper 2/3 & lower 1/3 of thigh by passing through the adductor hiatus to continue as popliteal a.

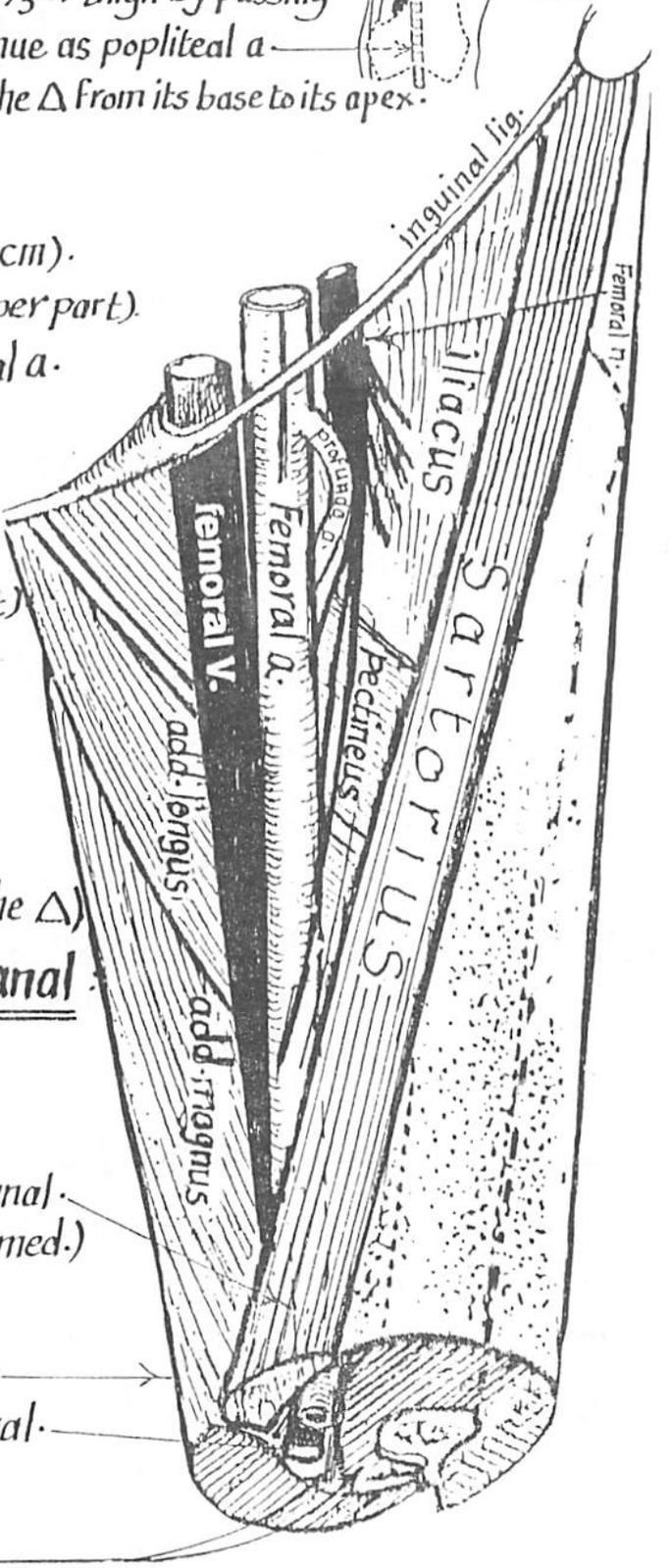
*__Relations in the femoral Δ__ : it traverses the Δ from its base to its apex.

-__Anteriorly__ :
(1) Skin, superficial & deep fascia
(2) ant. wall of femoral sheath (in the upper 4 cm).
(3) femoral br. of genito femoral n. (in the upper part).
(4) med. cut. n. of thigh crosses the femoral a. from lat. to med. near the apex of femoral Δ

-__Posteriorly__ (from above downwards) :
(1) post. wall of the femoral sheath.
(2) psoas major m. (separating it from hip joint)
(3) pectineus
(4) profunda vessels
(5) adductor longus m & femoral v. infront of it

-__Laterally__ : femoral n. & its branches.

__Medially__ : femoral v. (in the upper part of the Δ)



*__Relations in the Subsartorial Canal__ :

-__Anteromedially__ :
1) Skin, Superficial & deep fascia
2) Sartorius & the fibrous roof of subsartorial canal.
3) Saphenous n. (crosses the artery from lat. to med.)

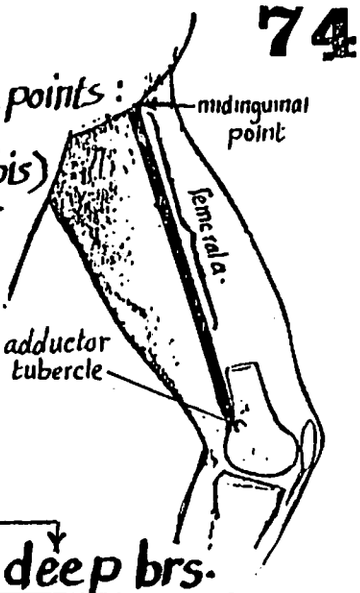
-__Posteriorly__ :
(1) adductor longus & adductor magnus.
(2) femoral v. : in the upper part of the canal.

-__Laterally__ :
(1) Vastus medialis & its nerve.
(2) Femoral Vein (in the lower part of the canal).

* Surface anatomy of femoral artery :

it is represented by the upper 2/3 of a line connecting the following 2 points :

(1) midinguinal point (a point midway between A.S.I.S & Symplysis pubis)
(2) adductor tubercle (lies at the lower end of the cord-like tendon of adductor magnus when the thigh is semiflexed, abducted & laterally rotated).



Branches of femoral artery

3 Superficial brs.
- superficial epigastric a.
- » circumflex iliac
- » external pudendal

3 deep brs.
- deep external pudendal
- Profunda Femoris
- descending genicular a.

(1) Superficial epigastric a. :

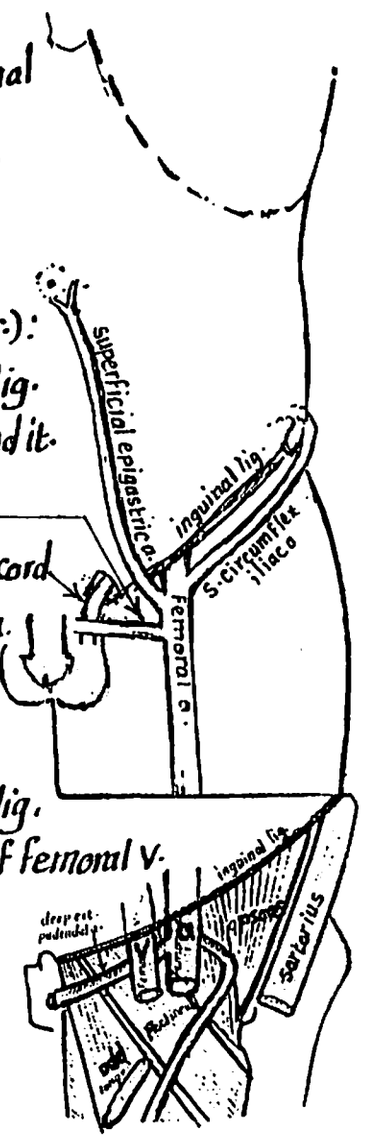
- arises 1 cm below the inguinal lig.
- pierces the cribriform fascia then ascends superficial to the inguinal lig. towards the umbilicus.
- it supplies the supeficial structures of the ant. abdominal wall
- it ends by anastomosing with the inf. epigastric a.

(2) Superficial circumflex iliac a. (the smallest superficial br.):

- pierces the fascia lata & runs laterally below & parallel to the inguinal lig. till it reaches the A.S.I.S where it shares in the anastomosis around it.

(3) Superficial external pudendal a.

- pierces the cribriform fascia & runs medially infront of spermatic cord & deep to long saphenous v. to supply the skin of external genitalia.



(4) Deep external pudendal a. :

- arises from the med. side of femoral a. ½ an inch below inguinal lig.
- passes medially on pectineus & addutor longus (behind or infront of femoral v.
- then it pierces the fascia lata to supply the external genitalia.

(5) Descending genicular a. :

- it is the only br. of femoral a. arising in the adductor canal (just above the adductor hiatus. It divides into 2 branches :

(a) saphenous br. : accompanies the saphenous n.
(b) articular br. : enters vastus medialis to reach the knee where it shares in anastomosis there.

6- Profunda femoris artery
(deep femoral artery)

*It is the largest br. of femoral a. & the main blood supply of the thigh.

*Origin: from the posterolat. aspect of femoral a. 4 cm below inguinal lig.

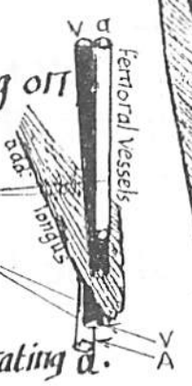
*Course & relations:

- at its origin it lies on the iliopsoas tendon.
- then it curves downwards & medially behind femoral vessels, lying on pectineus
- it leaves the femoral Δ by passing between pectineus & adductor longus
- then it descends deep to adductor longus, lying on the adductor brevis then adductor magnus

NB① the add. longus separates femoral vessels (ant. to it) from the profunda vessels (post. to it)

② the profunda v. lies ant. to the profunda a.

*The profunda a. Ends by becoming the 4th perforating a. which pierces the add. magnus m. close to the femur



*Branches of the profunda femoris a.

(1) Lateral circumflex femoral a.:

- runs laterally through the branches of the femoral n. (dividing them into superficial & deep branches).
- disappears deep to sartorius & rectus femoris where it divides into.

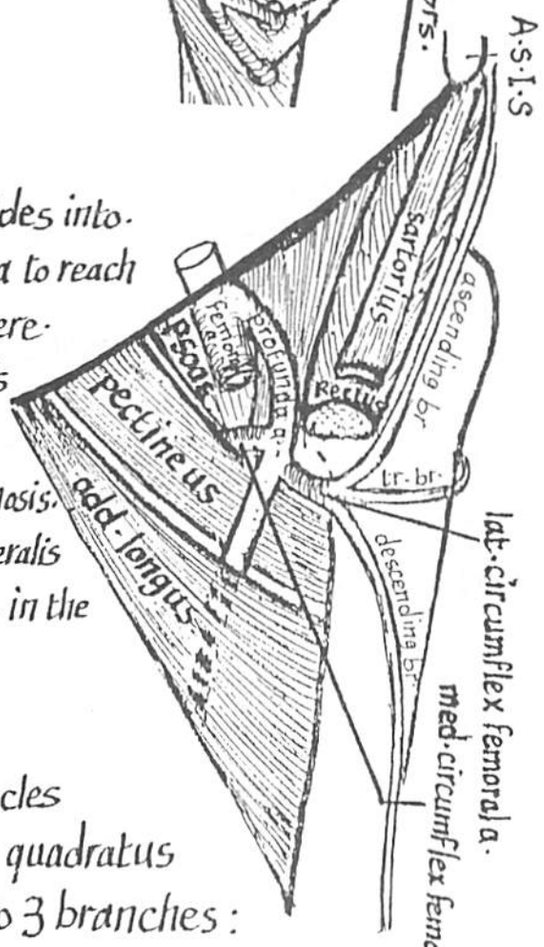
(a) ascending br.: ascends undercover of tensor fascia lata to reach the A.S.I.S to share in the anastomosis there.

(b) transverse br.: passes laterally then pierces vastus lateralis to wind round the femur just below the greater trochanter to reach the cruciate anastomosis.

(c) descending br.: descends along the ant. border of vastus lateralis (accompanied by n. to vastus lateralis) to share in the anastomosis around the knee.

(2) Medial circumflex femoral a.:

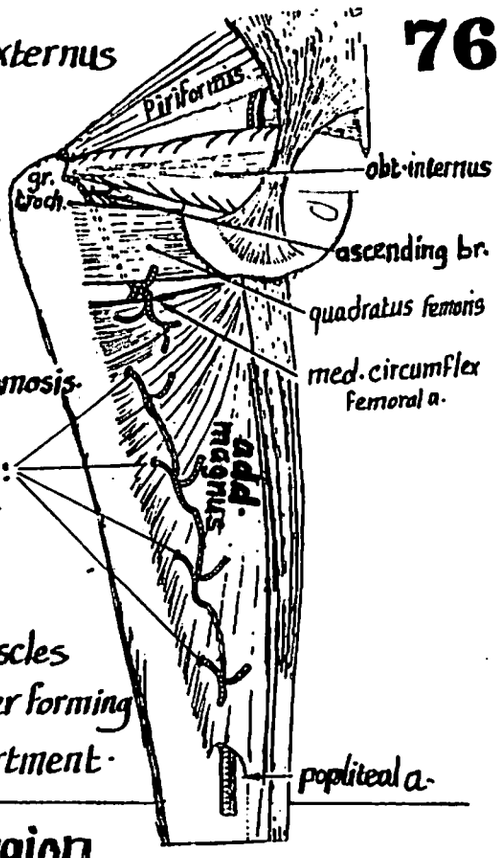
- passes posteriorly between psoas & pectineus muscles to reach the back of thigh where it appears between quadratus femoris & add. magnus where it ends by dividing into 3 branches:



(a) ascending br. accompanies the tendon of obturator externus to reach the trochanteric fossa sharing in the trochanteric anastomosis.

(b) acetabular br.: enters the acetabular foramen deep to the tr. acetabular lig. & sends a br. along the round lig of femur to supply its head.

(c) transverse br.: passes transversely to reach the cruciate anastomosis.



(3) Perforating branches of the profunda femoris:

- the first 3 are branches of the profunda while the 4th perforating a. is the continuation of the profunda itself.
- they perforate the insertion of add. brevis & add. magnus muscles to reach the back of the thigh where they anastomose together forming a longitudinal chain which supplies the muscles of the post. compartment.

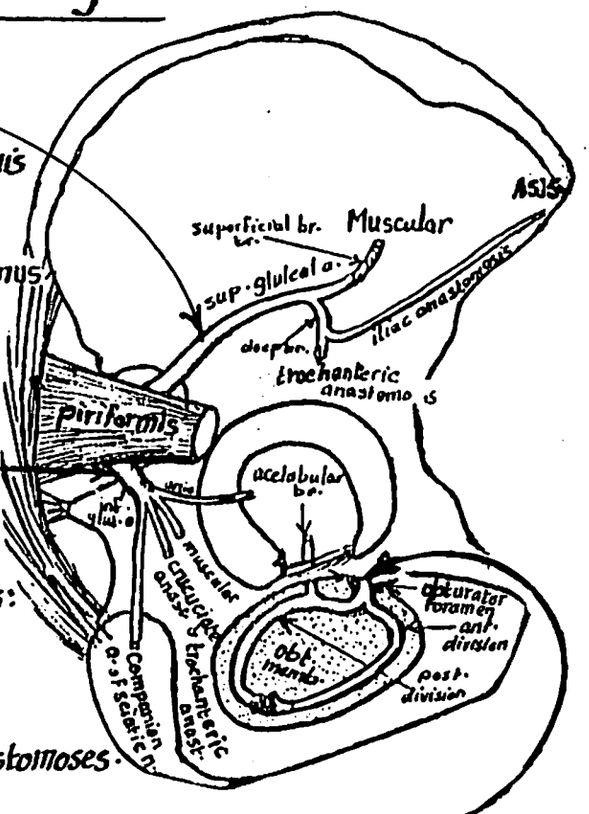
Other arteries of the thigh & gluteal region

(1) Superior gluteal a.

- arises inside the pelvis as a br. of internal iliac a.
- emerge through the greater sciatic foramen above piriformis
- in the gluteal region it divides into 2 branches:
 - (a) superficial br.: enters the deep surface of gluteus maximus
 - (b) deep br.: passes forwards between glut. med. & glut. minimus in company with sup. gluteal n.

(2) Inferior gluteal a.:

- arises inside the pelvis as a br. of internal iliac a.
- emerges from the greater sciatic f. below piriformis
- it supplies gluteus maximus m. & gives the following branches:
 - (a) accompanying br. to the sciatic n.
 - (b) articular br. to the hip joint.
 - (c) anastomotic brs. to the trochanteric & cruciate anastomoses.



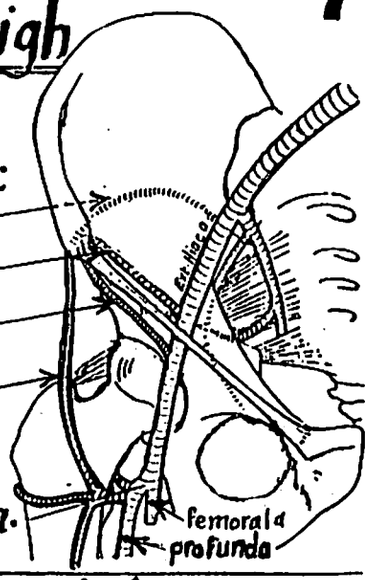
(3) Obturator a.:

- arises inside the pelvis as a br. of internal iliac a.
- enters the thigh by passing through the obturator foramen (accompanying obturator n.)
- divides into ant. & post. brs. which run along the margins of the obturator foramen & join each other in the form of a circle on the outer surface of the obturator membrane.
- Branches: (a) ant. & post. brs. which anastomose together.
 (b) acetabular br. (from the post. division): enters the hip joint via acetabular notch.
 (c) pubic br.: anastomses with the pubic br. of inf. epigastric a. on the back of pubis.

Collateral circulation (anastomoses) of the thigh

A) Anastomosis around the A.S.I.S:

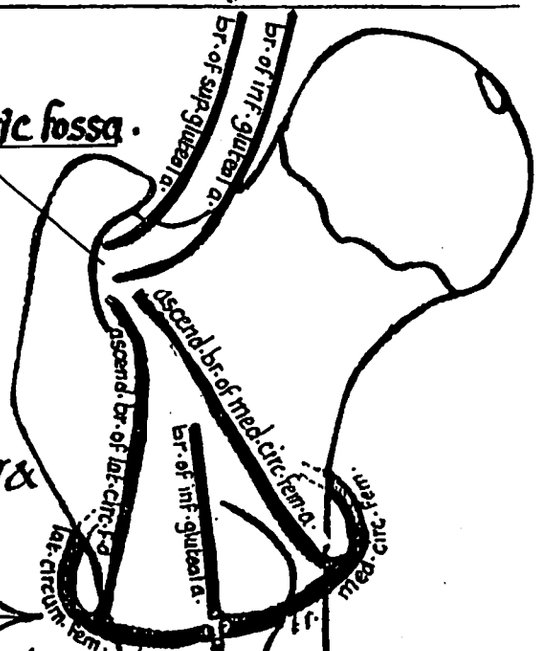
- is a relatively rich anastomosis between the following brs.:
 (1) br. from the sup. gluteal a. (from internal iliac a.)
 (2) deep circumflex femoral a. (» external iliac a.)
 (3) superficial circumflex femoral a. (from femoral a.)
 (4) ascending br. of lat. circumflex femoral (br. of profunda)
- This anastomosis provides a collateral anastomosis in case of obstruction of external iliac or femoral above the origin of profunda a.



(B) Trochanteric anastomosis:

- it is a rich anastomosis lying in the floor of the trochanteric fossa.
- it is formed by the following branches:
 (1) br. from sup. gluteal a. } from internal iliac a.
 (2) br. » inf. gluteal a. }
 (3) ascending br. of lat. circumflex femoral } from profunda
 (4) » » » med. circumflex femoral } femoris a.

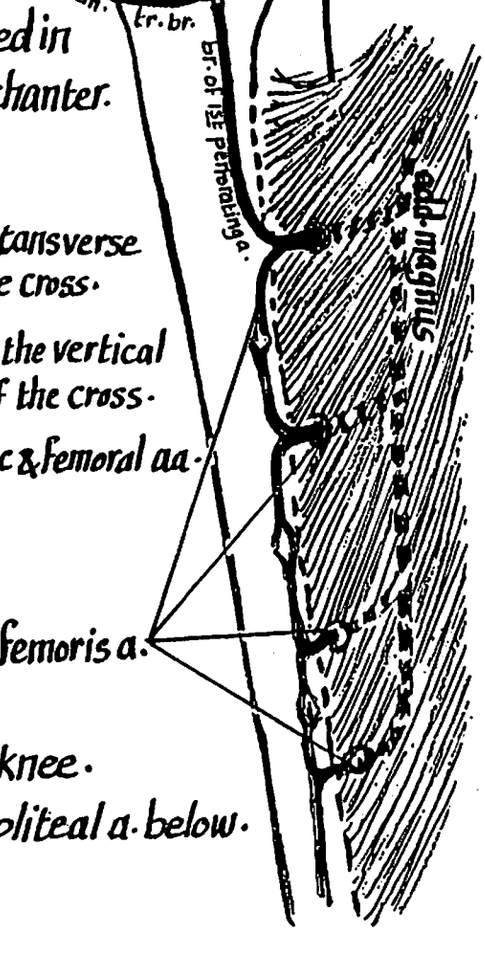
importance: it supplies retinacular arteries to the head of femur & connects the internal iliac a. with femoral a.



(C) Cruciate anastomosis:

- it is a rich anastomosis resembling a cross (+) situated in the upper part of back of thigh at the level of the lesser trochanter.
- it is formed by the following branches:
 (1) transverse br. of med. circumflex femoral a. } forming the transverse
 (2) » » » lat. » » » } part of the cross.
 (3) descending br. of inf. gluteal a. (of int. iliac a.) } forming the vertical
 (4) ascending br. of 1st perforating a. of profunda } part of the cross.

importance: it forms a connection between the internal iliac & femoral aa.



(D) The anastomosis on the back of thigh:

- it is a relatively rich anastomosis on the back of thigh formed by the perforating branches of the profunda femoris a.
- it is continuous above with the cruciate anastomosis.
- » » » below with the anastomosis around the knee.
- it connects the internal iliac artery above with the popliteal a. below.

Popliteal artery

* **Origin**: Continuation of the femoral a. at the adductor hiatus (at the junction of the middle & lower thirds of the thigh.)

* **Course**: it runs downwards & slightly laterally as the deepest (most ant.) structure in the popliteal fossa (in contact with its floor).

* **Termination**: at the lower border of popliteus m. by dividing into ant & post. tibial arteries.

* **Relations**:

(A) anterior (deep) relations:
- popliteal surface of femur
- back of capsule of knee joint
- fascia covering popliteus m.

(B) posterior (Superficial) " :

(1) in the upper part: it is overlapped by semimembranosus m.

(2) At the centre of the fossa it is crossed from lat. to med. by the popliteal v. & tibial nerve

(3) in the lower part: it is overlapped by gastrocnemeus & plantaris muscles.

Lateral relations:

(1) in the upper part: biceps m. popliteal v. & tibial n.

(2) in the lower part: plantaris & lat. head of gastrocnemeus.

Medial relations:

(1) in the upper part: semimembranosus & semitendinosus mm.

(2) " " lower " : tibial n., popliteal v. & med. head of gastrocnemius m.

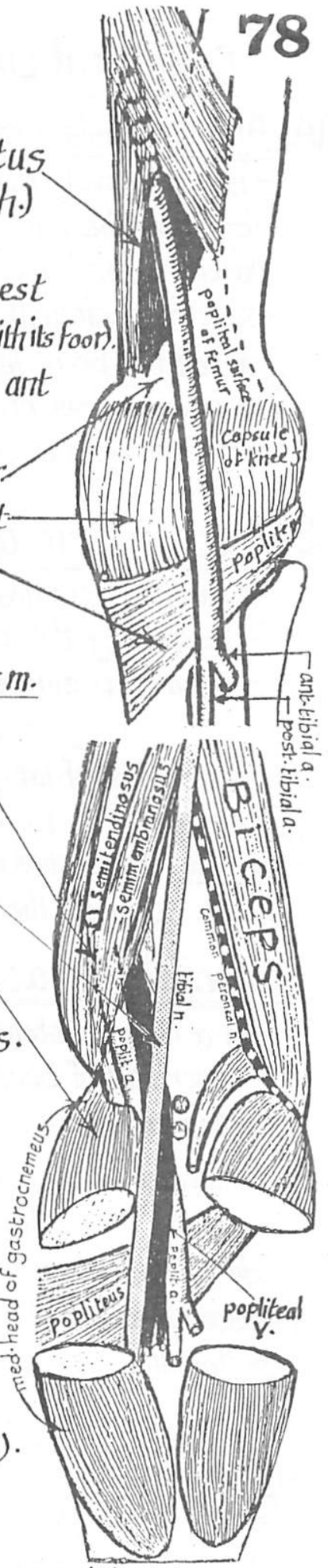
N.B: • the popliteal v. crosses superficial to the popliteal a. from lat. to med. (From love to Marriage)

• the tibial n. crosses superficial to the popliteal vessels (a. & v.) also from lat. (above) to med. (below).

* **Surface anatomy**: it is represented by a line connecting the following 2 points:

1 – a point on the med. side of back of thigh, at the junction of middle & lower thirds 1" medial to the middle line

2 – a point on the middle line of back of leg at the level of tibial tuberosity.



* Branches of the popliteal artery :

(1) Muscular brs. to hamstring & calf muscles

(2) 5 genicular branches :

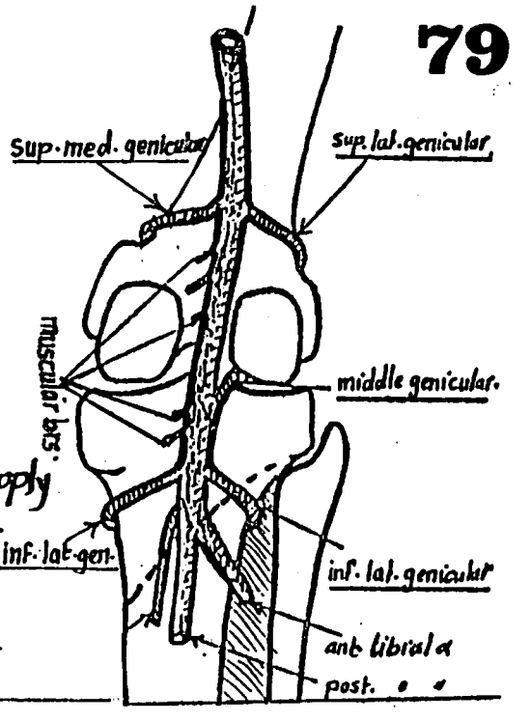
(a) sup. med. genicular } arise above the condyles of femur & wind round lower end of femur
(b) sup. lat. genicular }

(c) inf. med. genicular } arise below the tibial condyles & wind round upper end of tibia.
(d) inf. lat. genicular }

(e) middle genicular a. : pierces the oblique popliteal lig. to supply the cruciate ligaments & synovial membrane.

3) Sural a. : a small cutaneous br. accompanying sural n.

2 terminal branches : ant. tibial & post. tibial aa.



Anastomosis around the knee

it is a rich anastomosis around the knee formed by branches from femoral, popliteal, ant. & post. tibial arteries

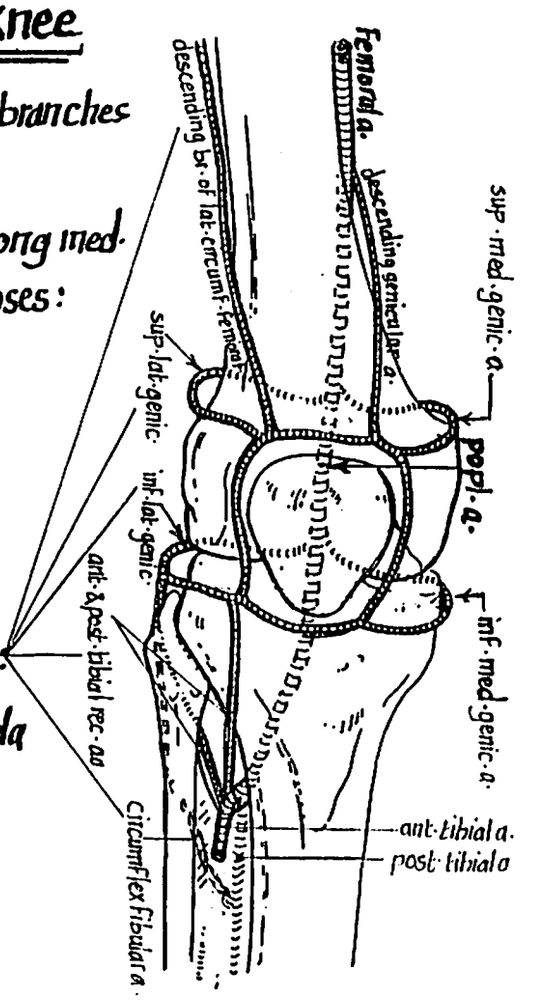
it is arranged as med. & lat. longitudinal channels along med. & lat. sides of the knee & connected by cross anastomoses :

A) The Medial longitudinal channel is formed of

(1) descending genicular a. : from femoral a.
(2) sup. med. genicular a. : " popliteal a.
(3) inf. med. genicular a. " popliteal a.

B) The Lateral longitudinal channel is formed of :

(1) descending br. of lat. circumflex femoral of profunda
(2) sup. lat. genicular a. : from popliteal a.
(3) inf. lat. genicular a. : " popliteal a.
(4) ant. tibial recurrent a. : " ant. tibial a.
(5) post. " " " : " " " "
(6) circumflex fibular a. : " post. tibial a.



Applied anatomy :

popliteal a. is more liable to aneurysm formation than other arteries in the body because :

1) Constant pulsations of the artery against the add. magnus tendon at the add. hiatus leads to changes in the vessel wall (weakness).

2) popliteal a. is fixed to the capsule of knee joint by a fibrous band just above femoral condyles (This may cause continuous traction on the artery).

Anterior tibial artery

* **Origin**: at the lower border of popliteus m. as the smaller of the 2 terminal brs. of the popliteal a.

* **Course**:
- at its origin it lies in the post. Compartment of leg..
- it passes forwards above the interosseous membrane to reach the ant. compartment lying med. to neck of fibula.
- in the upper part of its course it lies very deep infont of the interosseous membrane.
- in the lower part it deviates medially to lie infront of the lower part of tibia.

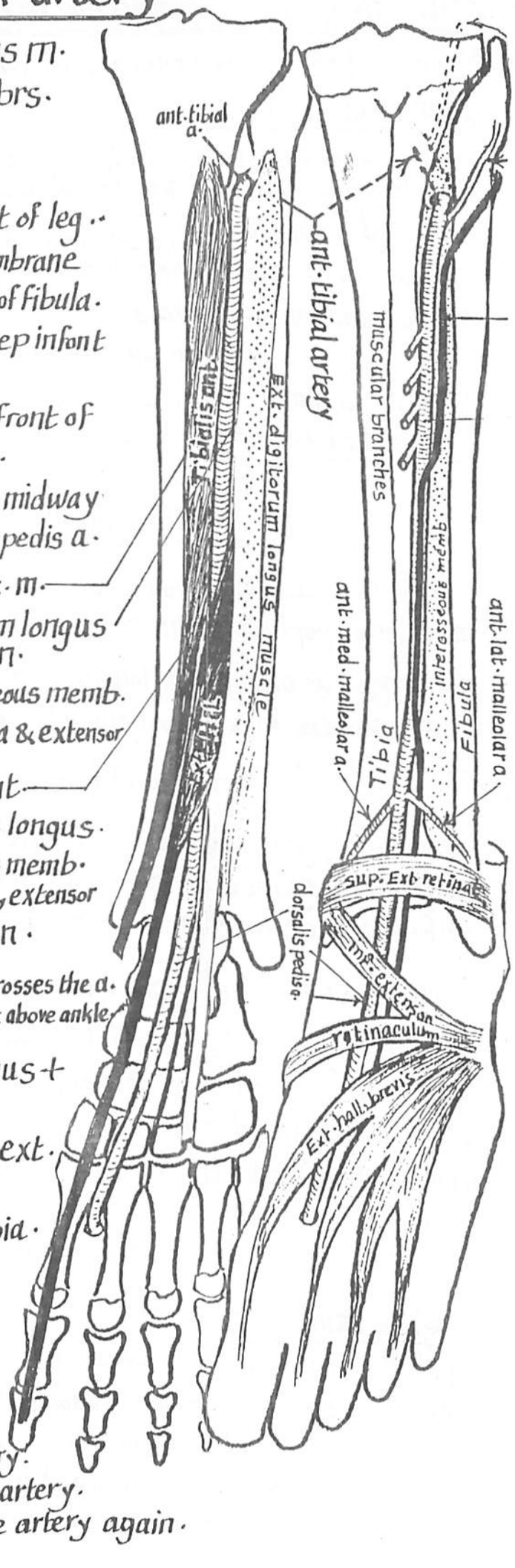
* **Termination**: it ends infront of ankle joint midway between the 2 malleoli by becoming the dorsalis pedis a.

* **Relations**:

I- its upper 1/3:
- medially: tibialis ant. m.
- laterally: ext. digitorm longus & ant. tibial n.
- posteriorly: interosseous memb.
- Anteriorly: skin, fascia & extensor muscles.

II- its middle 1/3:
- medially: tibialis ant.
- laterally: ext. hallucis longus.
- posteriorly: interosseous memb.
- anteriorly: skin, fascia, extensor muscles + Ant. tibial n.

III- Its lower 1/3:
- med.: ext. H. longus: crosses the a. From lat. to med. just above ankle.
- lat.: ext. digit. longus + ant. tibial n.
- ant.: skin, fascia + ext. Hall. longus.
- post.: lower end of tibia.



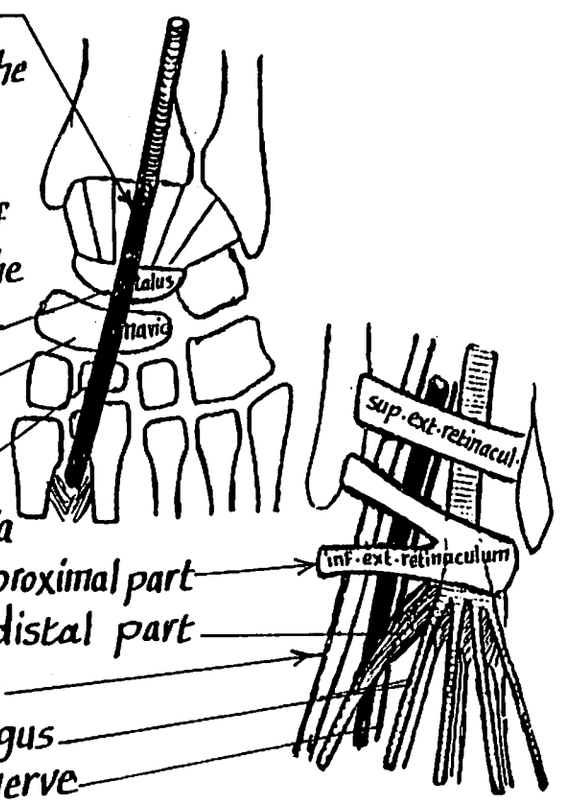
N.B:
(1) the artery is accompanied by 2 venae comitantes throughout its course.
(2) the ant. tibial n. has tripple relation with the ant. tibial a.
(a) in the upper 1/3: the nerve lies lat. to the artery.
(b) " " middle 1/3: " " " infront of the artery.
(c) " " lower 1/3: " " returns lat. to the artery again.

* Branches of ant. tibial a. :

(1) post. tibial recurrent a. : arises in the post. compartment of leg } share in the anastomosis around the knee joint.
(2) ant. " " " : " " " ant. " " " }
(3) muscular brs. : to the muscles of the ant. compartment of the leg.
(4) ant. med. malleolar : arises 5 cm above the ankle, passes deep to the tendons of tibialis ant. & ext. hallucis longus to reach the med. side of the ankle where it shares in the anastomosis there.
(5) ant. lat. malleolar : runs deep to the tendons of ext. digitorum & peroneus tertius to reach the lat. side of the ankle sharing in the anastomosis there.

Dorsalis pedis artery

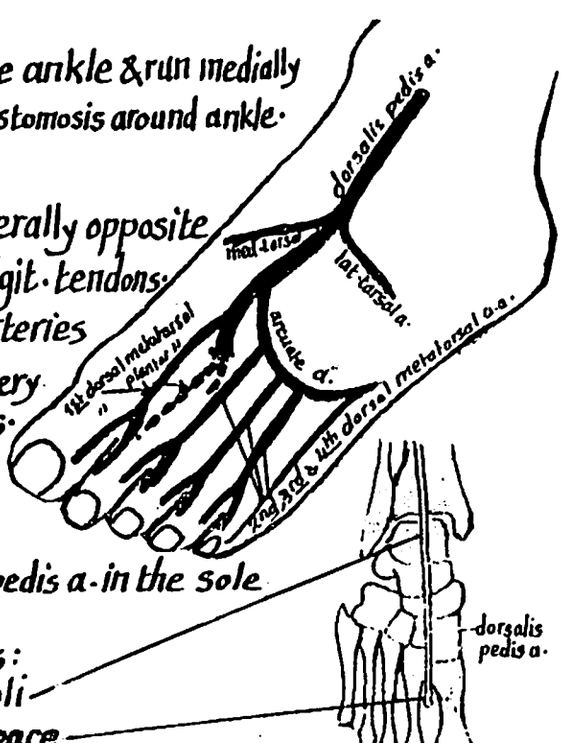
* **Begins** : infront of ankle joint, midway between the 2 malleoli as a continuation of ant. tibial a.
* **Course** : it passes forwards on the dorsum of the foot
* **Ends** : by passing downwards in the proximal part of the 1st interosseous space to reach the sole of the foot & anastomose with the end of the plantar arch



* **Relations** :
(A) **deep R.** : it crosses — neck of talus, navicular bone, intermediate cuniform.
(B) **Superficial R** : skin, superficial & deep fascia; inf. ext. retinac. crossing its proximal part; ext. hallucis brevis " " distal part
(C) **Medially** : extensor hallucis longus tendon
(D) **Laterally** : med. tendon of ext. digitorum longus; med. division of anterior tibial nerve

* **Branches** :
(1) med. tarsal a. } both arise immediately below the ankle & run medially
(2) lat. tarsal a. } & laterally respectively to share in the anastomosis around ankle.
(3) **Arcuate a.** :
- arises near the med. cuniform bone & curves laterally opposite the bases of metatarsal bones deep to the ext. digit. tendons.
- it gives the 2nd, 3rd & 4th dorsal metatarsal arteries which pass to the clefts between the toes & each artery divides into 2 dorsal digital brs. to adjacent sides of 2 toes.

(4) 1st dorsal metatarsal a. : arises from dorsalis pedis before it sinks into the sole
(5) 1st plantar metatarsal a. : arises from dorsalis pedis a. in the sole



* **Surface anatomy** : represented by a line between 2 points :
(a) a point infront of ankle midway between the 2 malleoli
(b) " " at the proximal end of the 1st metatarsal space

Posterior tibial artery

*Begins: at the lower border of popliteus m. as the larger of the 2 terminal branches of the popliteal a.

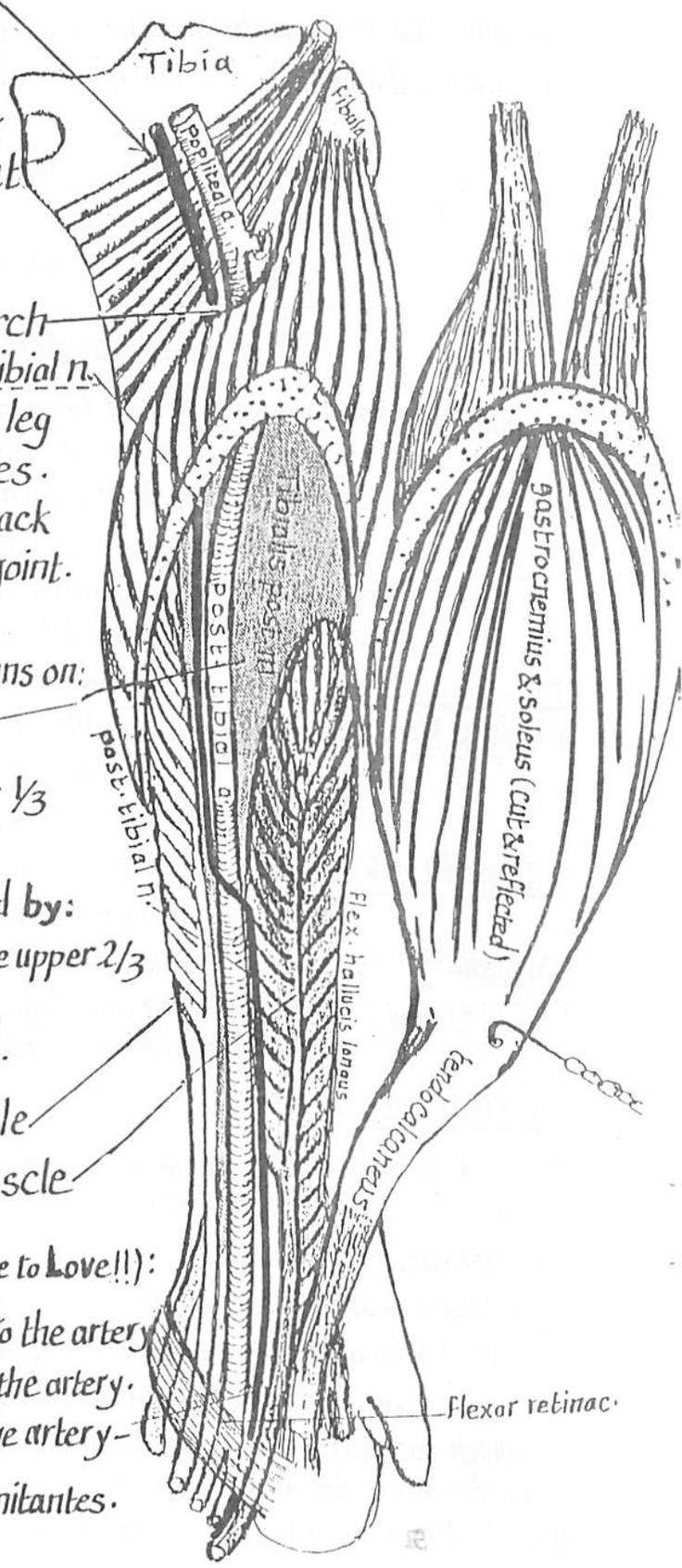
*ends: deep to the flexor retinaculum midway between med. malleolus & Calcaneus by dividing into med. & lat plantar arteries

* Course:

(1) it descends deep to the tendinous arch of soleus (between tibia & fibula) with post. tibial n.

(2) it runs downwards in the back of the leg between the superficial & deep calf muscles.

(3) in the lower part of the leg it lies on the back of lower end of tibia & capsule of the ankle joint.



* Relations:

(A) Deep relations: From above downwards it runs on:

(1) tibialis post. m. (in its upper 2/3)

(2) back of lower part of tibia } in its lower 1/3

(3) back of the ankle joint }

(B) Superficial (post.) relations: it is covered by:

(1) gastrocnemius & soleus muscles: in the upper 2/3

(2) skin & fascia only: in the lower 1/3.

(3) Flexor retinaculum: at its lower end.

(C) Laterally: Flexor hallucis longus muscle

(D) Medially: Flexor digitorum longus muscle

(E) Relations to post. tibial n. (from Marriage to Love!!):

(1) in the upper part: the nerve lies Medial to the artery

(2) in middle part: the n. crosses superficial to the artery.

(3) in the lower part: the nerve lies Lat. to the artery

NB: the artery is accompanied by 2 venae comitantes.

* Surface anatomy:

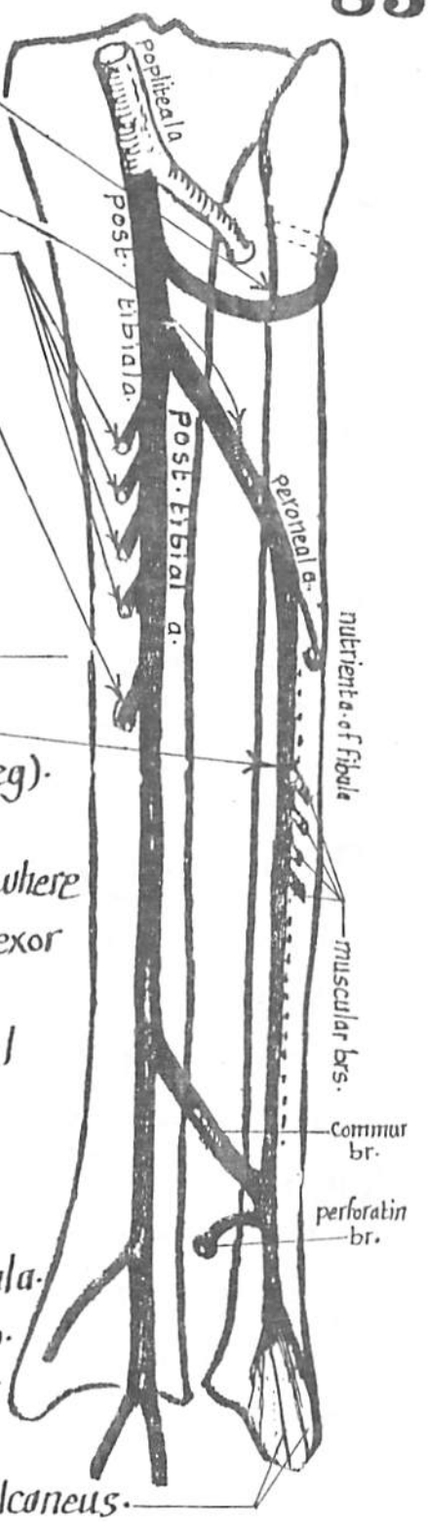
it is represented by a line joining the following 2 points:

(1) a point on the middle line of the back of leg at the level of tibial tuberosity.

(2) a point midway between med. malleolus & tendo calcaneus.

*Branches of post. tibial a.:

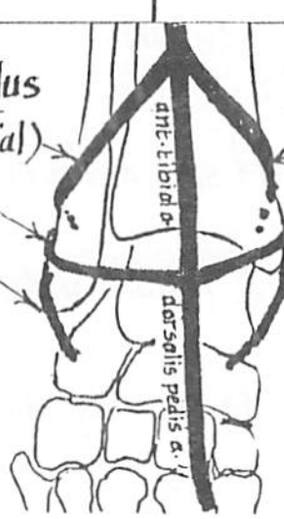
(1) Circumflex fibular a.: winds round lat. aspect of neck of fibula & shares in the anastomosis around the knee.
(2) Peroneal a.: see below.
(3) muscular brs.: to the muscles of back of leg
(4) nutrient a. of tibia: (the largest nutrient a. in the body):
(5) Communicating br.: runs across the back of lower end of tibia to join a similar br. from the peroneal a.
(6) med. malleolar: ramifies on the med. malleolus.
(7) med. calcanean: " " " med. side of calcaneus
(8) 2 terminal brs.: lat. & med. plantar arteries.



Peroneal artery

* it is the largest & longest br. of post. tibial a. (main supply of leg).
* **Origin**: arise 1 inch below the begining of the post. tibial a.
* **Course**: it descends downwards & laterally to reach the fibula where it runs down along its med. crest between tibialis post. & Flexor hallucis longus muscles.
* **termination**: behind the inf. tibiofibular joint by giving terminal Calcanean branches.
* **Branches**: (1) muscular.
(2) nutrient a. of fibula.
(3) Communicating br.: joins its fellow from post. tibial a.
(4) perforating br.: pierces the interosseous memb. 2" above ankle to reach the ant. compartment. It may replace the ant. tibial a.
(5) lat. calcanean (terminal) brs. to lat. side of Calcaneus.

Anastomosis around ankle



Anastomosis around lat. malleolus

(1) ant. lat. malleolar (br. of ant. tibial)
(2) lat. tarsal (br. of dorsalis pedis)
(3) lat. malleolar (From peroneal a.)
(4) lat. calcanean (" " a.)
(5) brs. from lat. plantar a.

Anastomosis around med. malleolus

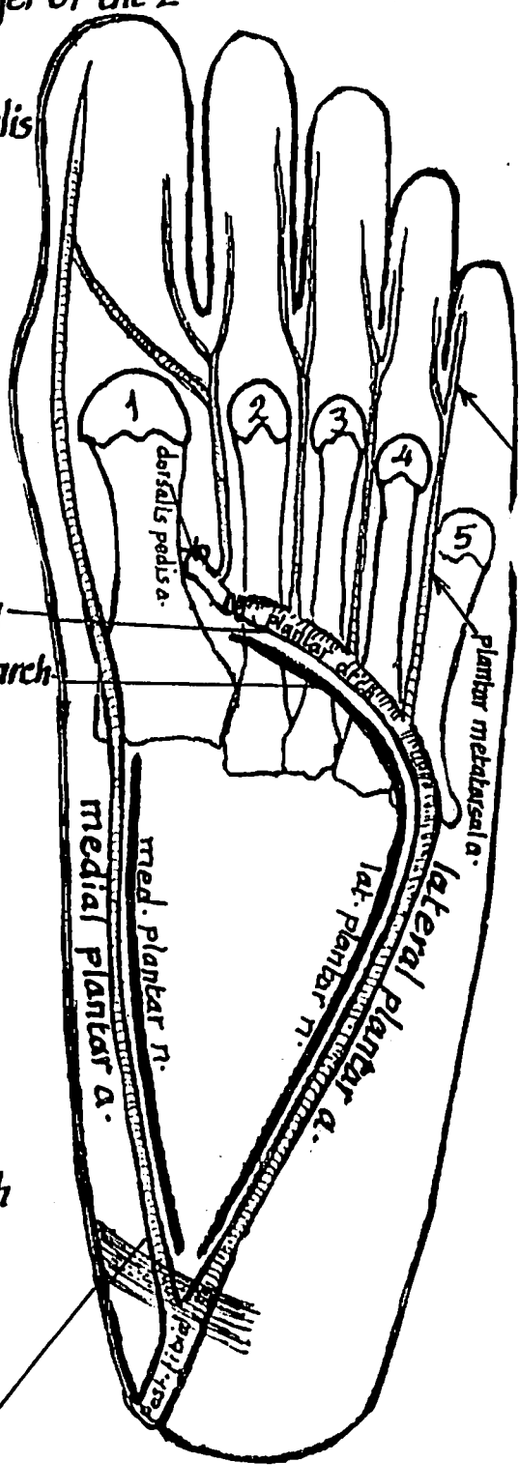
(1) ant. med. malleolar (ant. tibial
(2) med. tarsal (dorsalis pedis).
(3) med. malleolar (post. tibial).
(4) med. calcanean (" ").
(5) brs. from med. plantar a.

Lateral plantar artery

* **Begins**: undercover of the flexor retinaculum as the larger of the 2 2 terminal brs. of the post. tibial a.
* **Ends**: by anastomosing with the terminal part of the dorsalis a. to complete the plantar arch.

* **Course & relations:**

(1) it passes obliquely forwards & laterally across the foot in the direction of the base of the 5th metatarsal bone, lying between the muscles of the 1st & 2nd layers of the sole, with lat. plantar n. med. to the artery.
(2) then the artery turns medially across the foot between the 3rd & 4th layers of the sole forming the **Plantar arch**
The deep br. of lat. plantar n. lies in the concavity of the plantar arch



* **Branches of the plantar arch:**

(1) 3 plantar metatarsal arteries (the 2nd, 3rd & 4th) which pass to the clefts between the lat. 4 toes. Each artery divides into 2 plantar digital arteries supplying the adjacent sides of 2 toes.
N.B: the 1st plantar metatarsal a. arises from the dorsalis pedis a. as it enters the sole.
(2) 3 post. perforating arteries which pass upwards through the proximal ends of the 2nd, 3rd & 4th interosseous spaces to anastomose with the dorsal metatarsal arteries.
(3) plantar digital a. for the lat. side of the little toe.

Medial Plantar artery

* **Begins**: undercover of the flexor retinaculum as the smaller of the 2 terminal branches of the post. tibial a.
* **Course**: it runs forwards along the med. side of the medial plantar n. undercover of abductor hallucis muscle.
* **ends**: by joining the branch of the 1st plantar metatarsal a. to the med. side of the big toe.
* **Branches**: it gives off muscular brs. to the adjoining muscles.

Venous drainage of the L.L.

(I) Superficial Veins : run in the superficial fascia accompanied by superficial lymphatics. They include :

(1) **Dorsal Venous arch:**

- lies at the ant. part of dorsum of foot opposite the heads of the metatarsal bones
- receives venous blood from the dorsum & margins of the foot & also from the sole (by veins piercing the interosseous spaces)
- drains medially into long saphenous V. & laterally into short saph. V.

(2) Long (great) Saphenous Vein :

* It is the longes vein in the body (about 80 cm).
* **Begins** : at the med. side of the dorsum of foot as a continuation of the med. end of the dorsal venous arch of foot.
* **Course & relations :**

(a) it ascends infront of med. malleolus, lying 2 finger breadth infront of its post. border (Commonest site for venous cut-down).

(b) in the leg : it ascends along the med. border of tibia (behind the saphenous n.) to reach the post. part of med. side of knee (lying 4 finger-breadth behind post. border of patella).

(c) in the thigh : it ascends vertically along its med. aspect, then crosses the roof of the femoral △ to reach the saphenous opening.

* **Termination** : by piercing the cribriform fascia & the med. wall of the femoral sheath to end in the femoral vein.
* **Valves** : it contains 10 - 20 valves which are more numerous below knee. 2 valves are present in the upper end (one before the V. pierces the cribriform fascia & the other at the sapheno-femoral junction

* **Tributaries:**

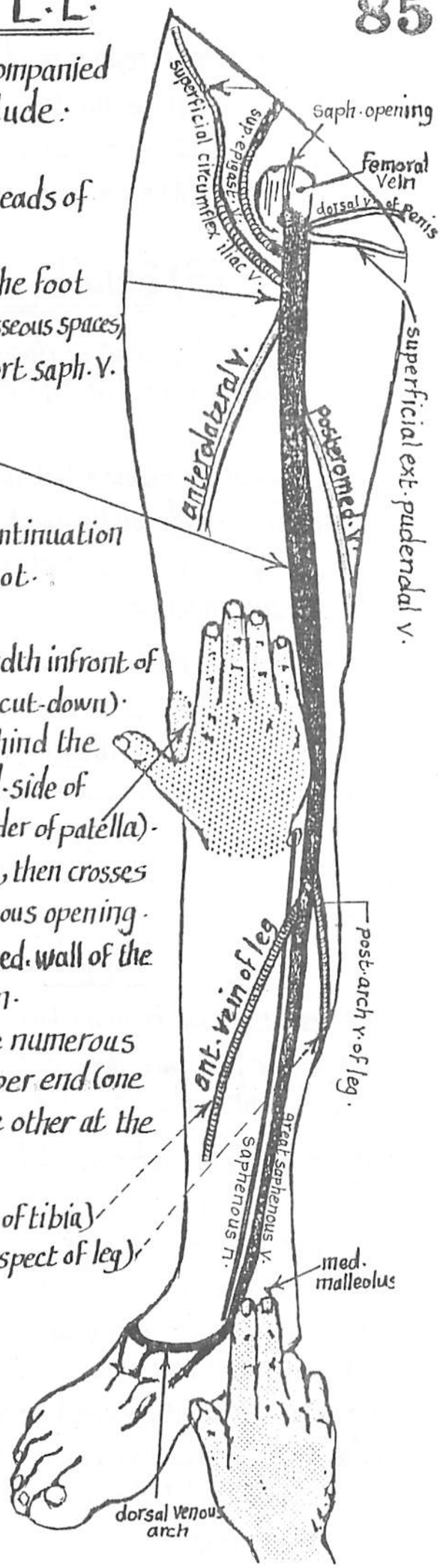
(1) Below knee : (a) ant. vein of leg (crosses the shin of tibia)
(b) post. arch V. (in the posteromed. aspect of leg).

(2) Above knee : (a) anterolat. V. of thigh.
(b) posteromed V. » ».

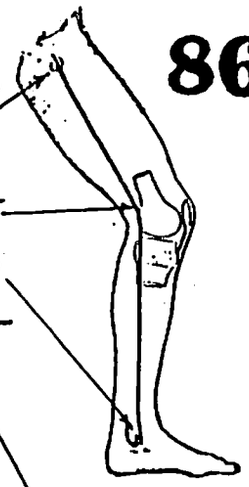
(3) At the inguinal region : (a) superficial epigastric V.
(b) » circumflex iliac V.
(c) » ext. pudendal V.
(d) » dorsal vein of penis

(4) Tributaries connecting it with small saphenous V.

(5) perforating veins connecting it with the deep veins of the leg & thigh.



*Surface anatomy: represented by a line connecting the following points:
(1) a point 4 cm below & lat. to the pubic tubercle
(2) " " just behind the adductor tubercle of femur
(3) " " " infront of the medial malleolus of tibia



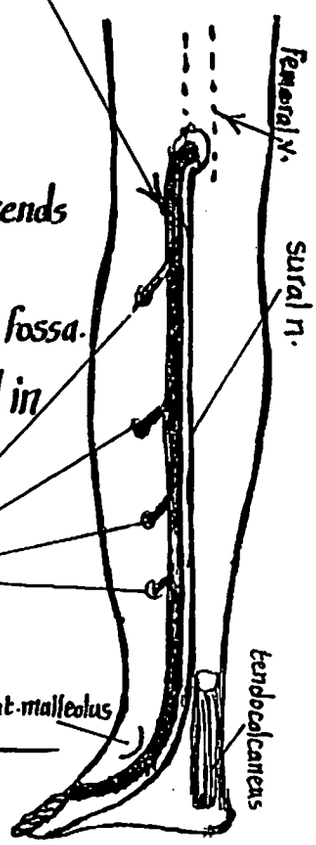
(3) Small (short) saphenous V.

*Begins on the lat. side of dorsum of foot as a continuation of the lat. end of the dorsal venous arch.

*Course:
(1) it curves below & behind the lat. malleolus.
(2) it ascends on the back of leg lat. to tendocalcaneus then ascends superficial to gastrocnemius accompanied by the Sural n.
(3) one inch below the knee it pierces the deep fascia roofing popliteal fossa.

*Termination: it passes between the 2 heads of gastrocnemius to end in the popliteal V.

*Tributaries & Communications:
(1) Communications with soleal venous plexus via perforating veins
(2) " " the great saphenous vein.
(3) unnamed tributaries from the foot & leg.



Applied Anatomy

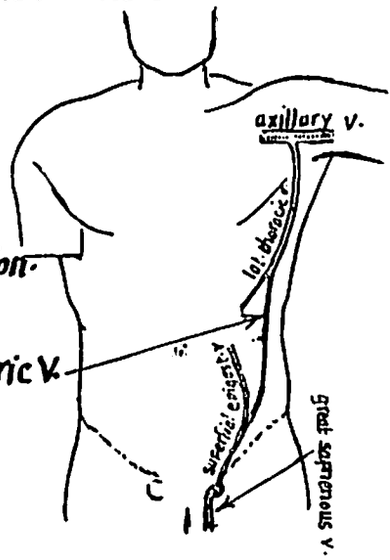
(1) The venous blood from the low pressure superficial veins (great & small saphenous veins) goes to the high pressure deep veins (femoral, popliteal & tibial vv.) via perforating veins provided with valves directing the blood towards the deep veins.

(2) Varicose veins (abnormal dilatation & tortuosity of the superficial veins of L.L.): result from abnormal flow of blood from the deep to the superficial veins due to incompetence of the valves.

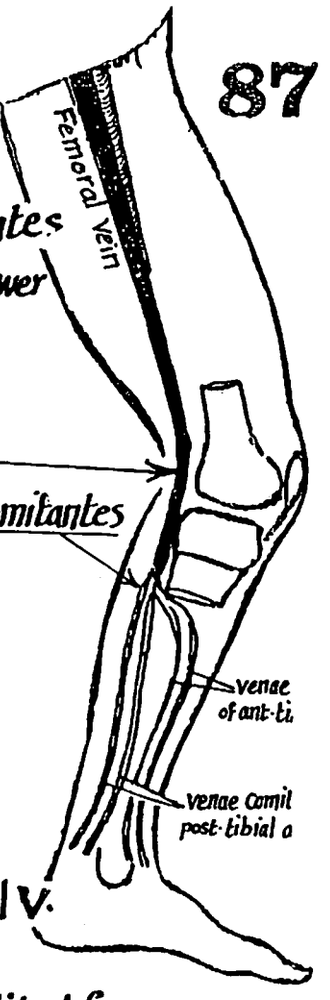
(3) great saphenous V. can be used as a graft replacing obstructed arteries e.g coronary arteries of the heart

(4) Venipuncture: can be done in the great saphenous V. infront of med. malleolus (constant position) for injection of solutions or blood transfusion.

(5) the superficial epigastric V. (tributary of great saphenous V. is connected to the lat. thoracic V. (tributary of axillary V.) via thoracoepigastric V. which runs in the superficial fascia of ant. abd. wall. This V. allows collateral circulation in case of obstruction of I.V.C.



II- Deep Veins of the L.L.



(1) **Venae Comitantes** of ant.& post.tibial aa:

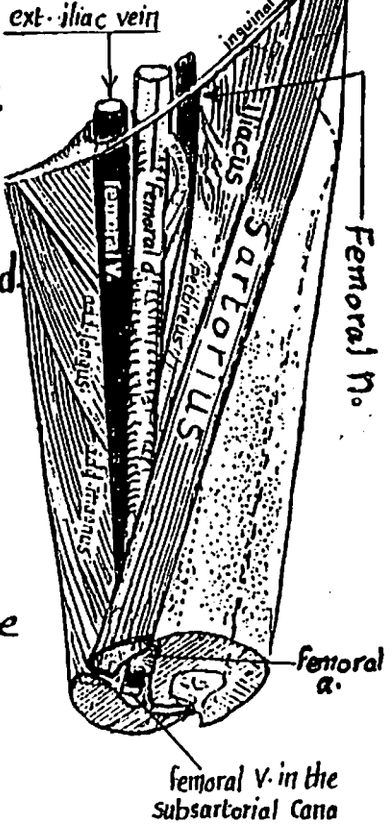
*each of the ant.& post.tibial a. is accompanied by 2 venae comitantes
*these venae comitantes ascend towards the knee & unite at the lower border of popliteus muscle to form the popliteal vein

(2) **The Popliteal Vein:**

*Begins at the lower border of popliteus m. by the union of the venae comitantes of the ant.& post. tibial arteries.
*Course & relations: (see page 56).
- at its begining, it lies med. then ascends behind the artery to end posterolateral to the artery at the adductor hiatus
- the tibial n. lies superficial to the vein being posteromed to the n. in the lower part & posterolat to it in the upper part.

*Ends: by passing through the adductor hiatus to continue as the femoral V.
*Tributaries:
(1) Short saphenous v.: joins the popliteal V. at the middle of popliteal fossa.
(2) the 5 genicular veins accompanying the branches of the popliteal artery.

(3) **Femoral Vein:**



*Begins: at the adductor hiatus as a continuation of popliteal V.
*Course & relations:
(1) its lower ½: lies in the subsartorial canal being posterolateral to femoral a. at the lower end & post. to the a. at the upper end.
(2) its upper ½: lies in the femoral Δ becoming med. to the artery at the upper part.

N.B: its uppermost 4 cm of the V. lies in the intermediate compartment of the femoral sheath, with the femoral canal med. to it.

*Ends: by passing behind the inguinal lig. to continue as the external iliac V. in the abdomen.
*Tributaries:
(1) Long saphenous vein.
(2) profunda femoris vein.
(3) deep external pudendal vein.
(4) med. circumflex femoral V. } they accompany their arteries & end in the femoral
(5) lat. circumflex femoral V. } vein instead of the profunda V.

Lymphatic drainage of the L.L.

(A) Superficial lymphatics (drain the skin & subcutaneous tissue):
- the majority of vessels follow the great saphenous V. to end in the superficial inguinal L.Ns.
- few lymphatics (from lower part of leg) follow the short saphenous V. to end in the popliteal L.Ns.

(B) Deep lymphatics (drain structures beneath the deep fascia):
- they are less numerous than the superficial lymphatics.
- they accompany the arteries (ant. & post tibial, popliteal & femoral).
- they end in the popliteal & deep inguinal L.Ns.

Lymph Nodes of L.L.

I- Superficial inguinal L.Ns:

*Site: in the superficial fascia of the roof of the femoral Δ

*groups: they are arranged in 2 groups (vertical & horizontal):

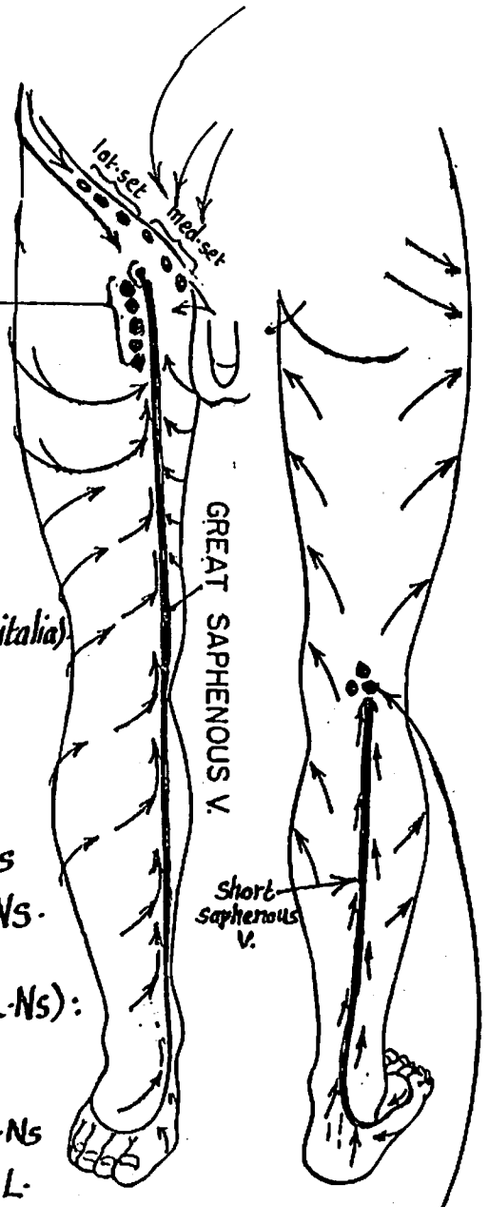
(1) the Vertical group (homologous to lat. axillary group):
- lie along lat. side of upper end of the great saphenous V.
- it drains almost all superficial structures of the L.L.

(2) Horizontal group: formed of 2 sets:

(a) med. set (homologous to the pectoral group of axillary L.Ns):
- it lies below the med. part of the inguinal lig.
- it drains the ant. abdominal wall below umbilicus (including genitalia)

(b) lat. set (homologous to the scapular group of axillary L.Ns):
- it lies below the lat. part of the inguinal lig.
- it drains the back of the trunk below the iliac crest

*Efferent lymphatics from all the above-mentioned L.Ns pierce the cribriform fascia to drain into the deep inguinal L.Ns.



II- Deep inguinal L.Ns: (homologous to apical axillary L.Ns):

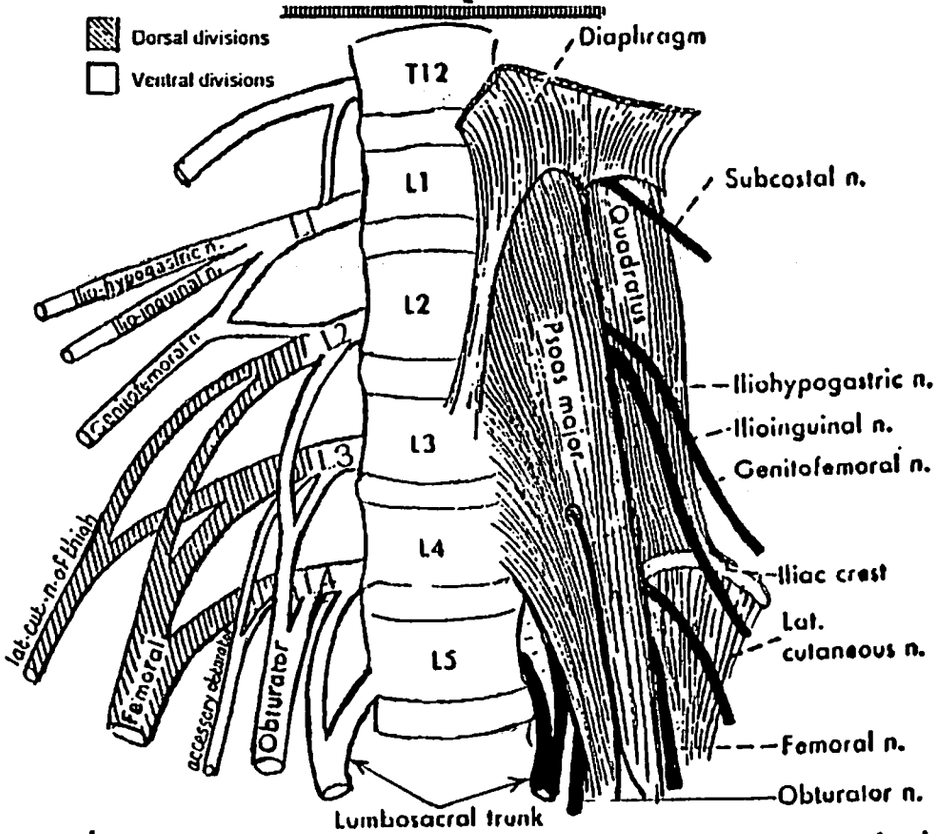
- Site: lie along the med. side of the femoral V.
- receive afferent lymphatics from (1) superficial inguinal L.Ns
 (2) all deep structures of the L.L.
 (3) efferent lymphatics from the popliteal L.Ns.
- Send efferent lymphatics to the external iliac L.Ns in the abdomen.

III- Popliteal L.Ns: →

- they lie along the popliteal vessels beneath the deep fascia in the popliteal fossa.
- they receive afferent lymphatics passing alongside short saphenous V. & tibial vessels.
- they send efferent lymphatics to the deep inguinal L.Ns.

1- *Lumbar plexus*

Formation & branches of lumbar plexus



Exit of the branches from psoas major m.

*Site : it lies inside the post-part of the substance of psoas major m. in the abdomen

*Formation : by the ant. ry rami of the upper 4 lumbar nerves (L1, 2, 3, 4). Each of which (except L1) divides into ant. (ventral) & post. (dorsal) divisions.

*Branches of the plexus :

Large branches	Small branches	Distribution of the roots of the plexus
(1) Femoral n. from post. divisions of L2, 3, 4	(3) iliohypogastric (L1)	L1 gives: Iliohypogastric n.; Ilioinguinal n.; 1st root of genitofemoral n.
(2) Obturator n. from ant. divisions of L2, 3, 4	(4) ilioinguinal (L1)	L2 gives: 2nd root of genitofemoral n.; 1st root of lat.cut.n.of thigh; 1st root of obturator n.; 1st root of femoral n.
	(5) genitofemoral (L1, 2)	L3 gives: 2nd root of lat.cut.n.of thigh; 2nd root of obturator n.; 2nd root of femoral n.
	(6) lat.cut.n. of thigh (post. divisions of L2, 3)	L4 gives: 3rd root of obturator n.; 3rd root of femoral n.; upper root of lumbosacral trunk
(7) Accessory obturator n. is frequently present and arises from the ventral divisions of L3 & L4		

*Exit of the branches from the psoas major muscle :

(1) obturator n.
(2) accessory obturator n. } emerge from the medial border of psoas major.
(3) lumbosacral trunk.

(4) iliohypogastric n.
(5) ilio inguinal nerve
(6) lat. cut. n. of thigh
(7) Femoral nerve
} emerge from the lat. border of psoas major.

(8) Genitofemoral nerve: emerges from the ant. surface of psoas major.

Individual branches of lumbar plexus



(1) Iliohypogastric n. (L1):
- for details of its course: see abdomen
- it divides into:
(a) lat. cutaneous br. supplies posterolat. aspect of buttok.
(b) ant. " br.: " skin of the abd. above the pubis.

(2) Ilio Inguinal n. (L1):
- for details of its course: see abdomen
- it emerges through the superficial inguinal ring to supply skin of upper part of the external genitalia.

(3) Lateral cut. n. of thigh (dorsal divisions of L2,3):
- emerges from the lat. border of psoas
- descends downwards & laterally on iliacus m. towards the A.S.I.S.
- it enters the thigh by passing behind the lat. end of the inguinal lig.
- it ends by dividing into ant. & post. terminal branches
(a) the ant. br.: supplies the skin of lat. aspect of thigh down to the knee
(b) " post " : " " " " " " " " till its middle

(4) Genitofemoral n. (L1,2):
- it emerges from the ant. surface of psoas major m.
- it descends infront of the muscle towards the inguinal Lig.
- it ends shortly above the inguinal lig. by dividing into 2 brs.:
(a) Genital br.: supplies the skin of the external genitalia + cremasteric m.
(b) Femoral br.: descends infront of the femoral a. in the lat. compartment of the femoral sheath then pierces the lat. wall of the sheath to supply the skin of the upper part of the femoral Δ.

(5) Lumbosacral trunk:
- it is formed by br. from L4 + the 5th lumbar n.
- it emerges from med. side of psoas & descends to the pelvis to share in the sacral plexus.

N.B: the 4th lumbar n. is a link between the lumbar & sacral plexuses so it is named **Nervus Furcalis** (forked nerve).

Obturator nerve

*It is the nerve of the med. (adductor) compartment of the thigh

*Origin: from the ventral divisions of L2, 3, 4

*Course & relations:

1- it emerges from the med. side of psoas major m.

2- it runs downwards & forwards on the side wall of the pelvis to reach the upper part of obturator foramen (obturator canal)

(3) while in the canal, it divides into ant. & post. divisions:

(A) the anterior division:

- passes above the upper border of obturator externus m.
- it runs downwards infront of adductor brevis muscle (behid pectineus & add. longus muscles).
- it gives the following branches:

(1) muscular: to add. longus, add. brevis & gracilis.

(2) cutaneous: to lower part of anteromed. aspect of thigh

(3) articular br. to the hip joint.

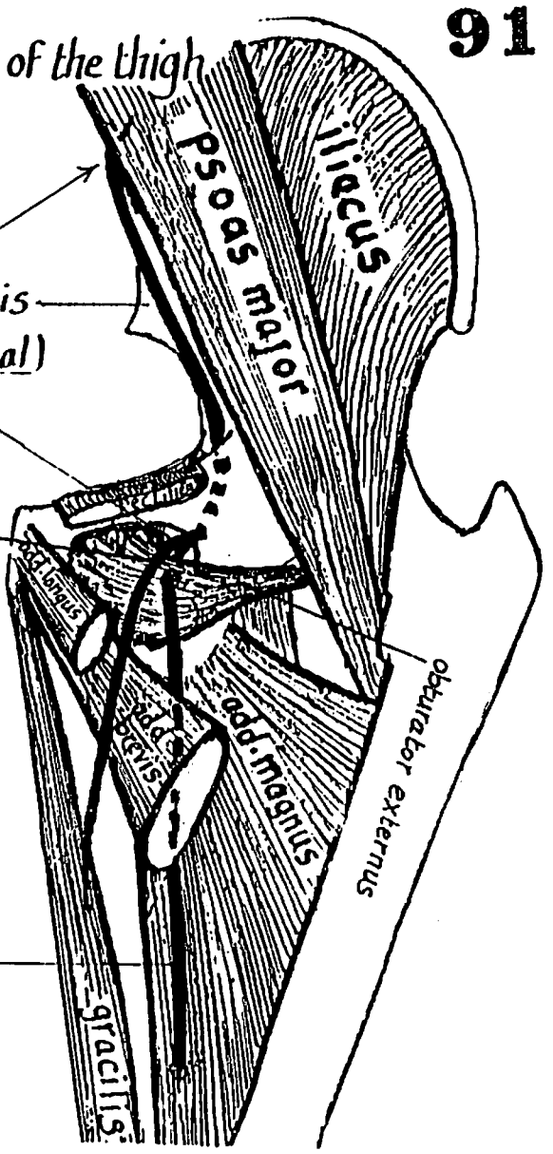
(B) the Posterior division:

- pierces the upper part of obturator externus m.
- it descends behind the add. brevis m. & infront of add. magnus
- it gives the following branches:

(1) muscular to: add. brevis, pubic part of add. magnus & obturator externus.

(2) articular to the knee joint

N.B: the cutaneous br. of the ant. division joins the subsartoral plexus of nerves



Accessory Obturator nerve

- it is present in 30% only of people

*Origin: from the ant. divisions of L3, 4

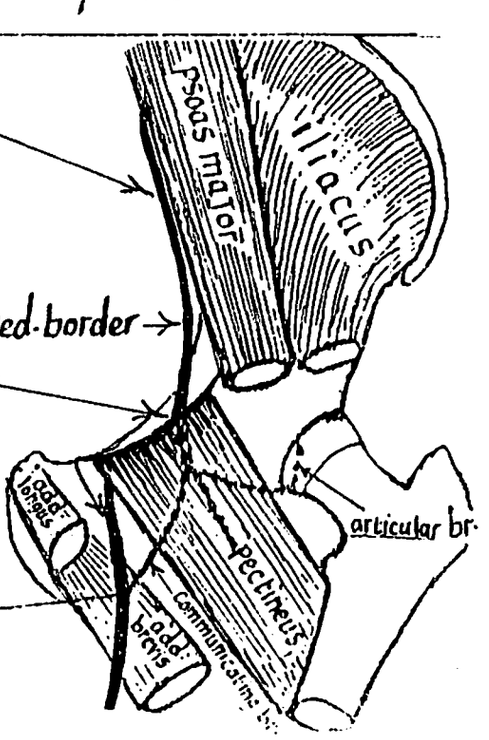
*Course & relations:

- it emerges from the med. side of psoas & descends along its med. border
- it enters the thigh by crossing infront of the sup. pubic ramus & deep to the pectineus m. where it ends by giving:

(a) muscular br. to pectineus m.

(b) articular br. to the hip joint

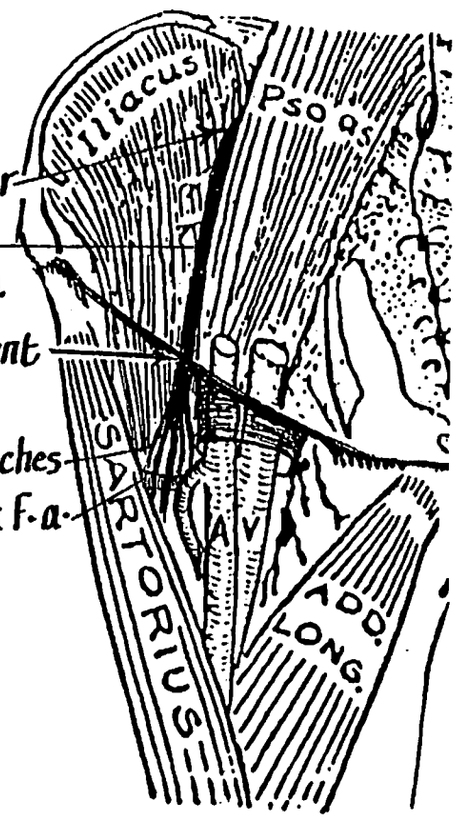
(c) Communicating br. to the ant. division of obturator n.



Femoral nerve

* It is the largest br. of the lumbar plexus.
* it is the nerve of the ant. compartment of thigh.

* **Origin** : from the dorsal divisions of L2, 3, 4.

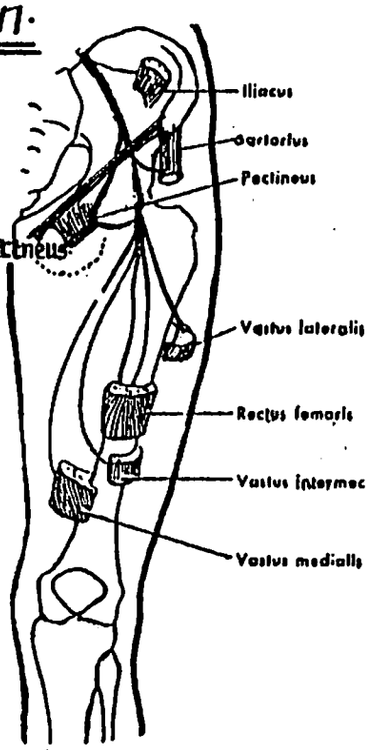


Course & relations :

- it emerges from lower part of lat. border of psoas major
- it descends in the groove between psoas & iliacus m. (behind the iliac fascia of the post. abdominal wall).
- it enters the thigh by passing behind the inguinal ligament lat. to the femoral artery but outside the femoral sheath.
- one inch below the inguinal lig. it ends by breaking into branches which are divided into ant. & post. groups by lat. circumflex f. a.

- The **anterior** group of branches include :
 - (a) muscular brs. to sartorius m.
 - (b) cutaneous brs. - med. cut. n. of thigh.
 - intermediate cut. n. of thigh.
- The **posterior** group of branches include
 - (a) muscular to (1) pectineus (2) quadriceps (3 vasti + rectus femoris.
 - (b) cutaneous br. : saphenous n.
 - (c) articular brs. : (1) articular br. to hip joint (from the n. to rectus femoris).
 (2) " " " knee " (from brs. to quadriceps m.).

Comment on the branches of the Femoral n.



I- Motor brs. of the femoral n. :

(1) br. to iliacus m. (before femoral n. enters the thigh).
(2) br. to pectineus m. (arises from the med. side of femoral n. just above the inguinal lig. & passes behind femoral sheath to supply the front of pectineus.
3) 1-2 brs. to sartorius (from the ant. group brs.).
4) 1-2 brs. to each head of quadriceps (from post. group of brs.).

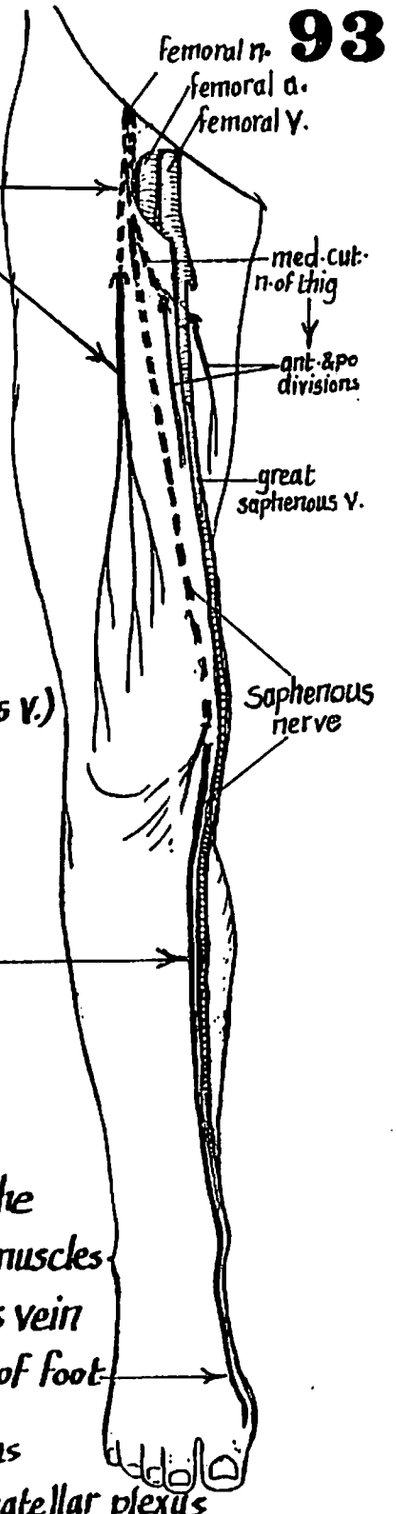
- Articular brs. :

(1) br. to hip joint : supplied by the n. to rectus femoris.
(2) " " knee joint : supplied by the nerves to the 3 vasti.

N.B : n. to vastus medialis contains the maximum proprioceptive fibres to the knee joint (this accounts for its large size).

II- Vascular brs. : to femoral a. & its branches.

V- Cutaneous brs. of the femoral n. :



(1) Intermediate cut. n. of thigh :

- it is one of the ant. division brs. of the femoral n.
- it pierces the deep fascia at the junction of upper 1/3 & middle 1/3 of the thigh.
- it supplies the skin of the intermediate area of front of thigh.

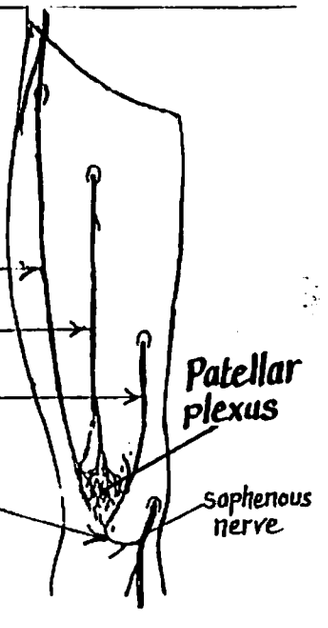
(2) Medial Cutaneous n. of thigh :

- it is one of the ant. division brs. of the femoral n.
- it lies first lat. to the femoral a. then crosses to the front of the artery near the apex of the femoral Δ
- it divides into ant. & post brs. (in relation to the great saphenous V.) which pierce the deep fascia of the thigh about its middle.
- it shares in the subsartorial plexus of nerves & supplies the skin of med. side of the thigh.

(3) Saphenous nerve : (the longest n. in the body) :

- it is one of the post. divion branches of the femoral n.
- it lies lat. to femoral a. in the femoral Δ then crosses to its med. side in the subsartorial canal.
- it leaves the subsartorial canal by piercing the deep fascia on the med. side of knee between the tendons of sartorius & gracilis muscles
- it descends on the med. side of leg infront of the great saphenous vein down to the front of med. malleolus then runs along the med. border of foot till the M.P joint of the big toe.
- Branches of saphenous nerve :
 - (1) br. to subsartorial plexus
 - (2) infrapatellar br. to the patellar plexus
 - (3) cut. brs. to med. side of leg & med. border of foot

Patellar plexus of nerves



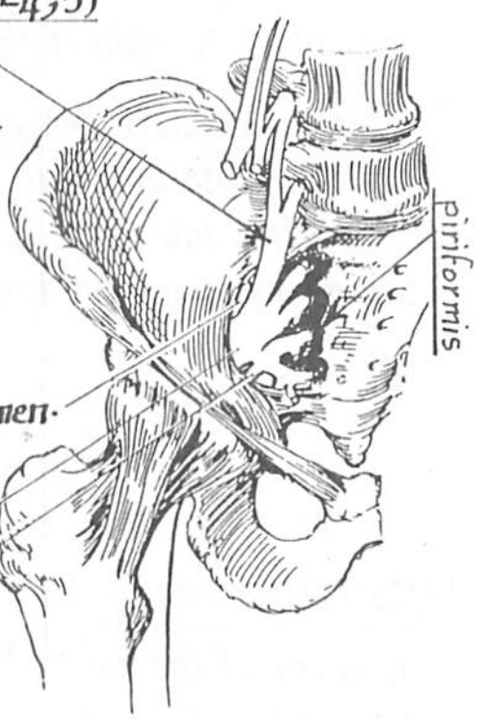
- it is a small nerve plexus lying over the patella & patellar lig.
- it is formed by the following nerves :

(1) ant. branch of the lateral cutaneous n. of thigh.
(2) the intermediate cutaneous nerve of thigh.
(3) the ant. branch of the medial cutaneous n. of thigh.
(4) the infrapatellar branch of the saphenous nerve

Sacral plexus

* It is the nerve plexus concerned with the supply of :
(a) muscles of gluteal region, back of thigh & all muscles of the leg & foot.
(b) Skin of back of thigh & all skin of the leg & foot except the med. side.

* **Formation** : it is formed of the lumbosacral trunk ($L_{4,5}$) & the ventral rami of S1, 2, 3 & the upper part of S4
Each of these nerve roots divides into ant. & post. divisions).



* **Site & Relations** :
- it lies on the post. pelvic wall infront of piriformis m. & behind the internal iliac vessels, ureter, sigmoid colon (on Lt. side) & terminal part of the ileum (on the Rt. side).
- the roots converge towards the lower part of the greater sciatic foramen. where they unite forming a triangular band which ends by dividing into : (a) a large upper terminal band (sciatic n.)
(b) a small lower " " (pudendal n.)

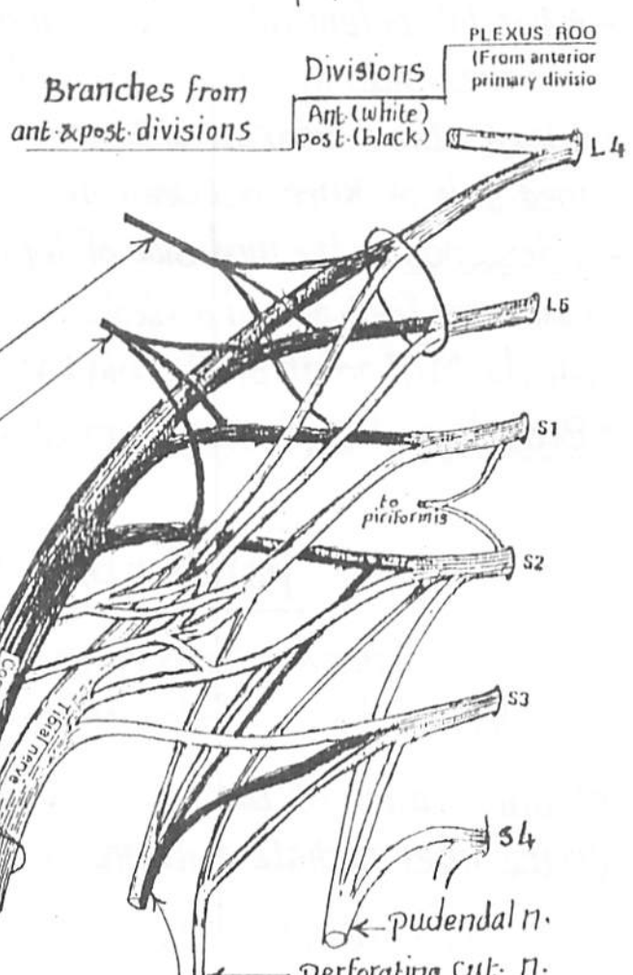
* **Branches of the plexus :**

(A) Branches from the **roots** : (5 **Ps**) :
(1) n. to **P**iriformis (S1, 2).
(2) **P**erforating cut. n. of thigh (S2, 3)
(3) **P**elvic splanchnic n. (parasymp.) : S2, 3, 4
(4) **P**erineal br. of 4th sacral n.
(5) **P**udendal n. (S2, 3, 4).

(B) Branches from **post.** divisions :
(1) sup. gluteal nerve ($L_{4,5}$, S1)
(2) inf. gluteal nerve (L_{5}, S1, 2)

(C) Branches from **ant.** divisions :
(1) n. to quadratus femoris ($L_{4,5}$, S1)
(2) n. to obturator internus (L_{5}, S1, 2)

(D) Branches from both **ant.** & **post.** div.
(1) Sciatic n. — Com. peroneal part (post. division of $L_{4,5}$, S1, 2)
tibial part — ant. divisions of $L_{4,5}$, S1, 2, 3)
(2) Post. cut. n. of thigh (post. divisions of S1, 2 & ant. div. of S2, 3).



Comment on the important branches of the Sacral plexus

(1) **Perforating cut. n. of thigh (S2,3)**: perforates the sacrotuberous lig. & winds round the lower border of gluteus maximus to supply the skin on its lower med. part.

(2) **post. cutaneous n. of thigh (S1,2,3)**:

- leaves the pelvis through greater sciatic foramen below piriformis.
- it descends on the dorsal surface of sciatic n., covered superficially by gluteus maximus m. at the origin of hamstrings, it leaves the sciatic n. by passing superficial to the long head of biceps m. then continues along middle line of back of thigh just beneath the deep fascia.
- it pierces the deep fascia of the roof of the popliteal fossa to accompany the short saphenous vein to the middle of the calf where it ends.
- it gives the following **branches**:
 (a) gluteal brs. to supply the skin over inferolateral part of gluteus maximus.
 (b) perineal brs to " " " of the perineum.
 (c) brs. to the skin of back of thigh, popliteal fossa & upper ½ of the back of leg.

(3) **N. to quadratus femoris** (from ant. divisions of L4,5,S1):

- leaves the pelvis through greater sciatic foramen below piriformis m.
- descends on the back of ischium deep to sciatic n., obturator internus tendon & the 2 gemelli.
- it ends by supplying the quadratus femoris (through its ant. surface) + inf. gemellus & hip joint.

(4) **N. to obturator internus** (from ant. divisions of L5,S1,2):

- leaves the pelvis through greater sciatic foramen below piriformis.
- it gives br. to the sup. gemellus, then crosses the ischial spine lat. to internal pudendal a.
- it re-enters the pelvis through the lesser sciatic foramen to supply the obturator internus m.

(5) **Sup. gluteal n.** (L4,5,S1):

- leaves the pelvis through greater sciatic foramen above the piriformis m.
- it passes forwards between gluteus medius & gluteus minimus (accompanied by the deep br. of the sup. gluteal a.) then it divides into 2 branches (upper & lower):
 (a) the upper br. supplies gluteus medius (b) the lower br. supplies glut. minimus + tensor fasciae latae.

(6) **Inf. gluteal n.** (L5,S1,2):

- leaves the pelvis through greater sciatic foramen below piriformis m.
- it enters the deep surface of gluteus maximus m. to supply it.

(7) **Pelvic splanchnic n.** (parasympathetic, from S1,2,3): to pelvic viscera.

(8) **Pudendal n.** (from the roots S2,3,4):

- leaves the pelvis through greater sciatic foramen below piriformis m.
- crosses the back of the sacrospinous lig. to enter the lesser sciatic foramen.
- its detailed course is described in the pelvis.

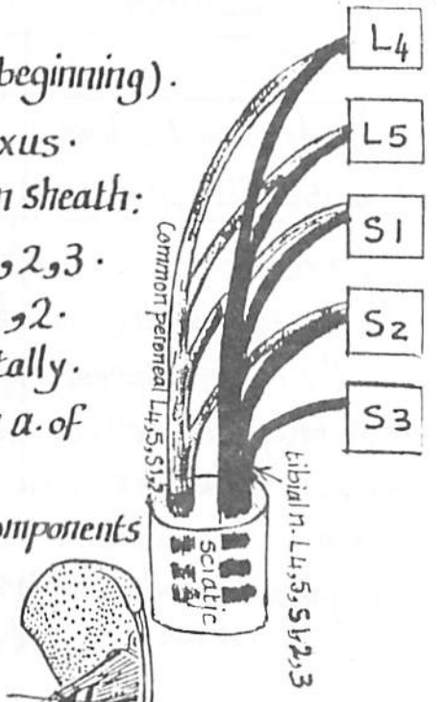
(9) **Sciatic N.**: see next page.

Sciatic nerve

* It is the thickest n. in the body (2 cm in diameter at its beginning).
* **Origin** : inside the pelvis as the largest br. of the sacral plexus.
* **Components**: the sciatic n. is formed of 2 parts having a common sheath:
 (1) tibial (med. popliteal) part : from ant. divisions of L4,5 & S1,2,3.
 (2) common peroneal (lat popliteal) part: from post " " L4,5 & S1,2.

N.B: (1) the sciatic n. is flat near its origin but becomes rounded distally.
(2) the sciatic n. is accompanied by an artery called companion a. of sciatic n. (a br. of inf. gluteal a.)

* **Variations** : the sciatic n. may be absent - In such case its 2 components arise directly from the sacral plexus & leave the pelvis as follows :
 (a) the tibial (med. popliteal) n. passes below the piriformis.
 (b) the common peroneal (lat. popliteal) n. : pierces the piriformis





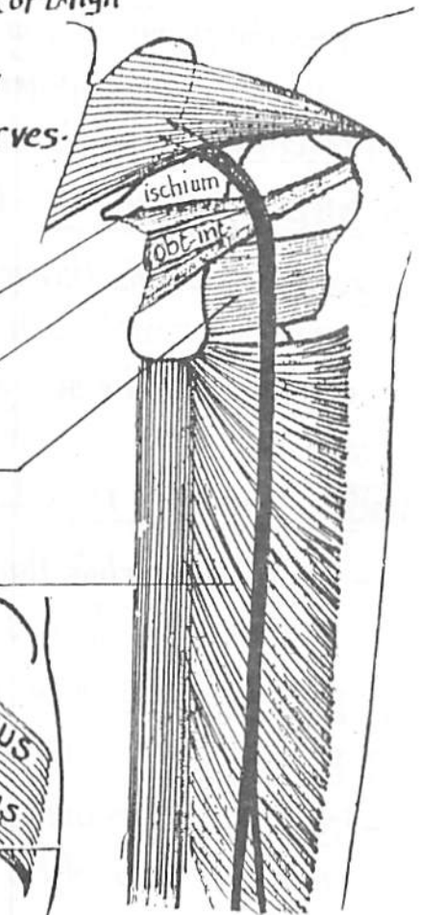
* **Course :**
 (1) it leaves the pelvis through the lower part of greater sciatic foramen below piriformis to reach the gluteal region.
 (2) in the gluteal region, it runs on the back of ischium downwards to a point midway between the ischial tuberosity & greater trochanter
 (3) then it runs vertically downwards along the middle line of back of thigh

* **Termination** : at the sup. angle of the popliteal fossa by dividing into the tibial & common peroneal nerves.

* **Relations** :

I- Deep Relations : (from above downwards):

(1) back of ischium (with n. to quadratus femoris inbetween)
(2) the tendon of obturator internus & 2 gemelli
(3) quadratus femoris muscle
(separating it from obturator externus m. & the hip joint).
(4) post. surface of adductor magnus muscle



II Superficial Relations :

(1) In the gluteal region : it is covered by gluteus maximus.
(2) " " back of thigh : it is crossed by long head of biceps.

III- Laterally : biceps femoris

IV- Medially : - post. cut. n. of thigh
- semimembranosus & semitendinosus muscles.

* Branches of Sciatic n.

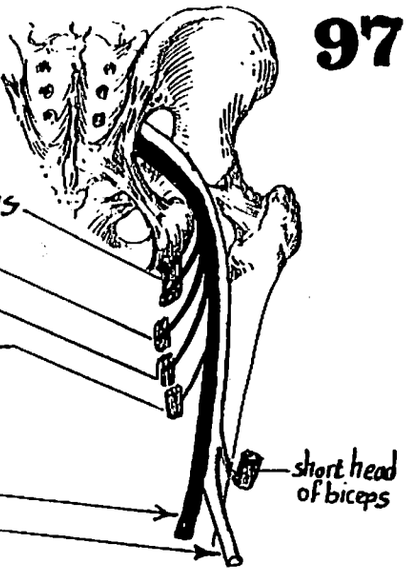
(1) Articular brs : to the hip joint

(2) Muscular brs :

(a) from its medial side (tibial par) to: → ischial head of add. magnus, semitendinosus, semimembranosus, long head of biceps

(b) from its lat. side (common peroneal ") to: → short head of biceps

(3) Terminal brs. : → tibial nerve, common peroneal nerve

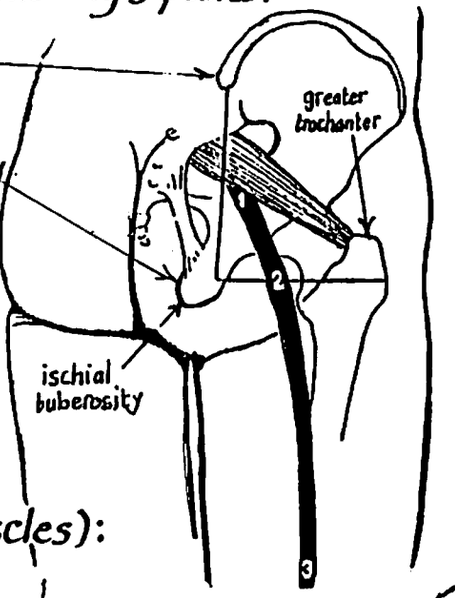


* **Surface anatomy** : it is marked by a line joining the following 3 points:

(1) a point 1" lat. to the midpoint between post. sup. iliac spine & the ischial tuberosity

(2) a point just medial to the midpoint between ischial tuberosity & the greater trochanter

(3) a third point in the middle line of back of thigh at the junction between the upper 2/3 & the lower 1/3



Injury of sciatic nerve

I- In the gluteal region (above the branches to hamstring muscles):

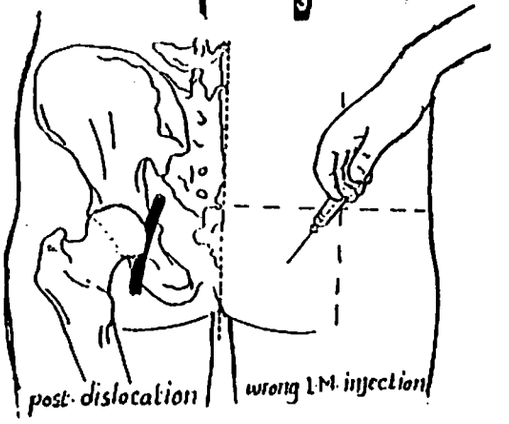
* Causes : (1) post. dislocation of hip joint
(2) wrong intramuscular injection (in the lower med. quadrant of gluteal region).
(3) penetrating wounds

* Effects :

(A) Motor : paralysis of → hamstring muscles, ischial part of add. magnus, all muscles of the leg & foot

(B) Sensory : loss of sensation from the leg & foot except the med. side which is supplied by the saphenous n. (br. of femoral n.).

(C) Deformity : foot drop.



II- In the back of thigh (below the branches to hamstring muscles):

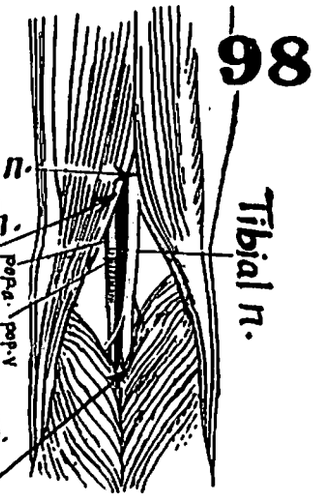
* Effects :

(A) Motor : like injury in gluteal region but hamstrings are intact.

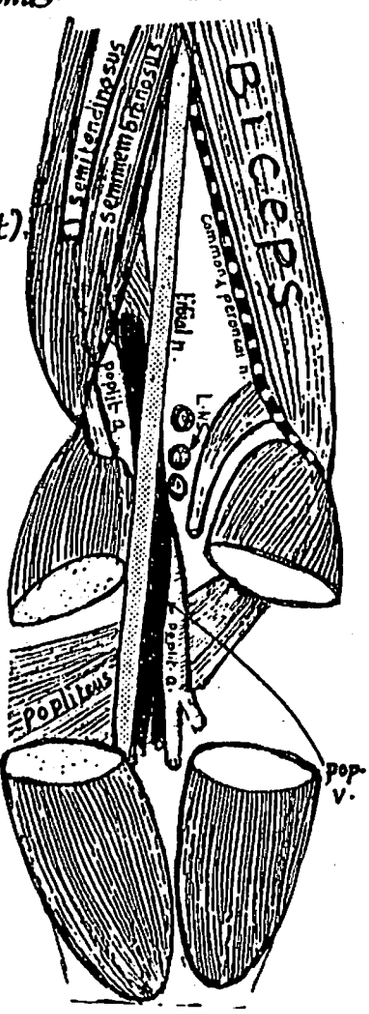
(B) Sensory : like injury in the gluteal region.

(C) Deformity : " " " " " ".

Tibial (med.popliteal) nerve



* **Root Value** : From ventral divisions of L4,5 & S1,2,3
* **Origin** : arises as the larger of the 2 terminal branches of sciatic n. at the junction of the upper 2/3 & lower 1/3 of the back of thigh.
* **Course** :
 (1) it enters the popliteal fossa through its upper angle.
 (2) it descends vertically in the middle line of the fossa bisecting it longitudinally, being the most superficial structure (post. to the vessels).
 (3) it leaves the fossa at its lower angle, between the 2 heads of gastrocnemius
* **Termination** : at the lower border of popliteus m. by becoming the post. tibial n. which enters the back of the leg.



* **Relations**:

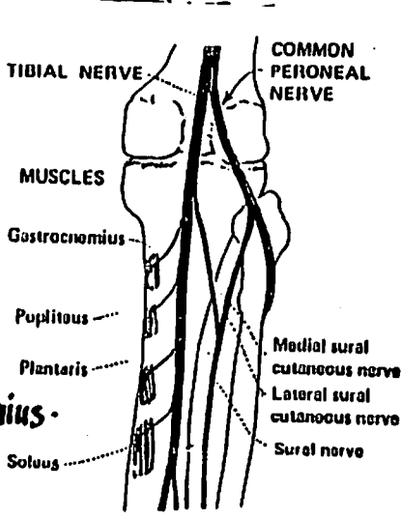
(A) **Superficially** (posteriorly) :
(1) Skin, fascia & hamstrings (in the upper part).
(2) " " & pad of fat (in the middle part).
(3) " " & gastrocnemius (" " lower ").

(B) **Deeply** (anteriorly) : popliteal vessels, separating the nerve from :
(1) popliteal surface of femur.
(2) back of knee joint.
(3) fascia covering the popliteus m.

N.B: the tibial n. has tripple relation with the popliteal vessels.
(a) in the upper part of the fossa : it lies posterolat. to the vessels.
(b) " " middle " " " " : " " posterior to the vessels.
(c) " " lower " " " " : " " posteromed. " " ".

(C) **Laterally** :- long head of biceps & common peroneal n. (above).
- lat. head of gastrocnemius & plantaris m. (below).

(D) **Medially** : - Semimembranosus & semitendinosus muscles (above).
- med. head of gastrocnemius muscle (below).



* **Branches**:
(1) **Muscular** to G.P.P.S — gastrocnemius, plantaris, popliteus, soleus
(2) **Articular** brs. to the knee joint : sup. med. genicular, inf. " ", middle genicular n.
(3) **Cutaneous** : the **Sural n.** :
- descends on the back of calf in the groove between the 2 heads of gastrocnemius.
- about the middle of the calf, it is joined by the sural communicating n. (br. of common peroneal n.) & pierces the deep fascia
- it passes with the small saphenous v. behind & below the lat. malleolus then along the lat. border of foot.
- it supplies : (a) posterolat. aspect of the lower 1/3 of leg. (b) the lat. border of the foot.

Posterior tibial n.

Origin: it begins as a continuation of the tibial n. at the lower border of the popliteus muscle.

Course:

(1) it descends deep to the tendinous arch between tibia & fibula to enter the back of the leg.

(2) it runs in the post. compartment of the leg between the superficial & deep groups of muscles.

3) in the lower end of the leg, it passes behind & below the med. malleolus, deep to the flexor retinaculum.

Termination: it ends deep to the " " " behind med. malleolus by dividing into med & lat. plantar nn.

Relations:

(A) **Superficial** (post.) relations:
- in the upper 2/3 it is covered by gastrocnemius & Soleus
- in the lower 1/3 it is covered by skin & fascia.

B) **Deep** (ant.) relations:
- in the upper 2/3: it lies on tibialis posterior muscle.
- in the lower 1/3: it lies on the post. surface of tibia.

C) **Medially**: Flexor digitorum longus muscle

D) **Laterally**: Flexor hallucis longus muscle

E) Relations to post. tibial a.:
- above: it lies med. to the a.
- in the middle: it crosses behind the a.
- below: it lies lat. to the a.

Branches:

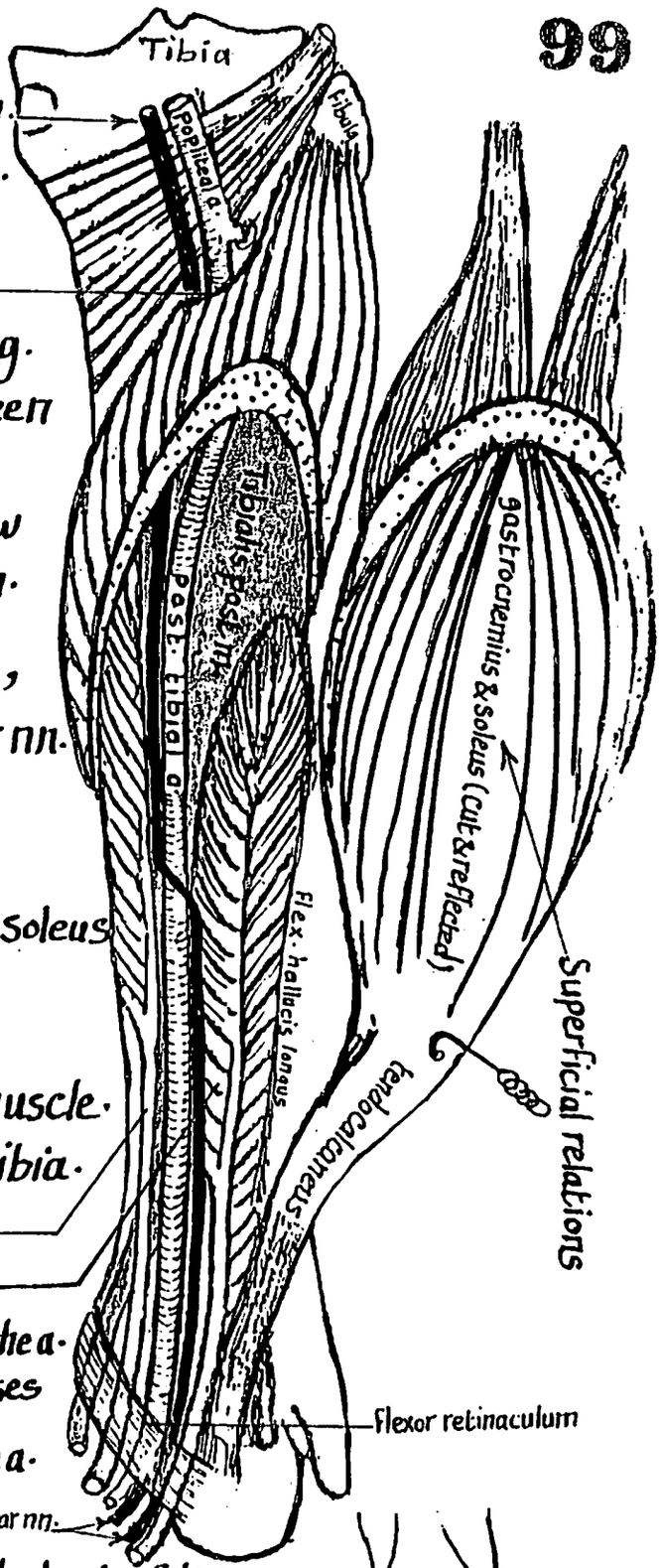
I- **Muscular**: to 3 deep & one superficial m. in the back of leg:
(1) Soleus m. (by a branch supplying its ant. surface)
(2) Flex. digit. longus (3) Flex. hall. longus (4) Tibialis posterior.

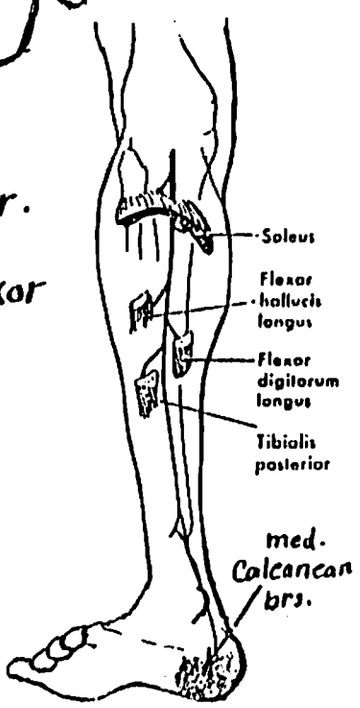
II- **Cutaneous**: med. calcanean branches which pierce the flexor retinaculum to supply the skin of the heel.

VI- **Articular**: to the ankle joint.

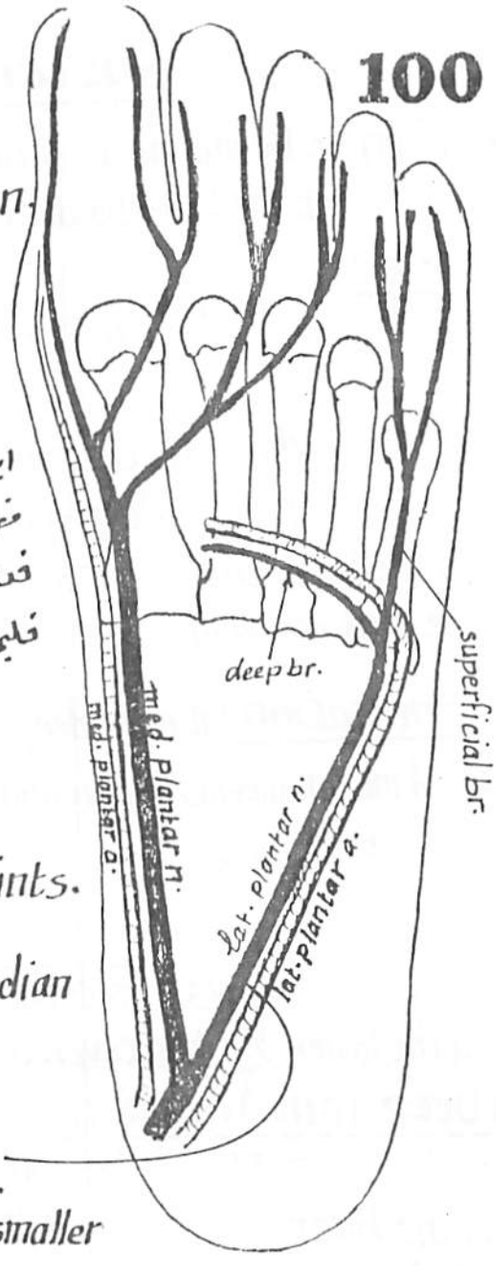
V- **Terminal brs.**: med. & lat. plantar nerves.

(see page 100)





The Medial plantar nerve



* **Origin**: arises deep to the flexor retinaculum as the larger of the 2 terminal branches of post. tibial n.
* **Course**: it runs forwards in the sole of the foot lat. to the medial plantar a., between the abductor hallucis & flexor digitorum brevis muscles.
* **Branches**:

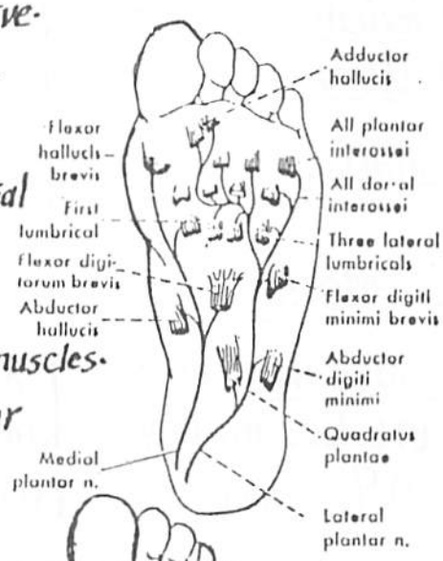
I- **Muscular** to 4 muscles:
(1) Abd. Hallucis — ابدوة
(2) Fl. Hallucis Brevis — مقرب
(3) Fl. Digitorum Brevis — قصير
(4) 1st lumbrical m — قلبي

II- **Cutaneous** to:
- skin of med. 2/3 of the sole.
- skin of the med. 3 ½ toes.

III- **Articular**: to the intertarsal & tarsometatarsal joints.

N.B: the med. plantar n. in the sole is similar to the median nerve in the hand.

Lateral Plantar nerve



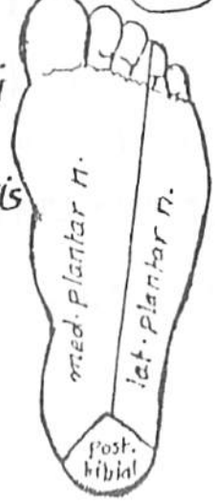
* **Origin**: undercover of the flexor retinaculum as the smaller of the 2 terminal branches of the post. tibial nerve.
* **Course**: it runs forwards & laterally on the med. side of the lat. plantar a. between the 1st & 2nd layers of the sole in the direction of the base of the 5th metatarsal bone & ends there by dividing into:
 (1) Superficial br.: divides into 2 plantar digital nerves to supply the skin of the lat 1½ toes + some muscles.
 (2) deep br.: turns medially in the concavity of the plantar arch between the 3rd & 4th layers of the sole, supplying many muscles of the sole.
* **Branches**:

(A) **Muscular** brs. to:
- fl. digit. accessorius & abd. digiti minimi (from the main trunk)
- add. hallucis, flex. digiti minimi brevis & lat. 3 lumbricals + the 7 interosseii (from the terminal brs.)

(B) Cutaneous: to skin of lat. ⅓ of sole & lat. 1½ toes.

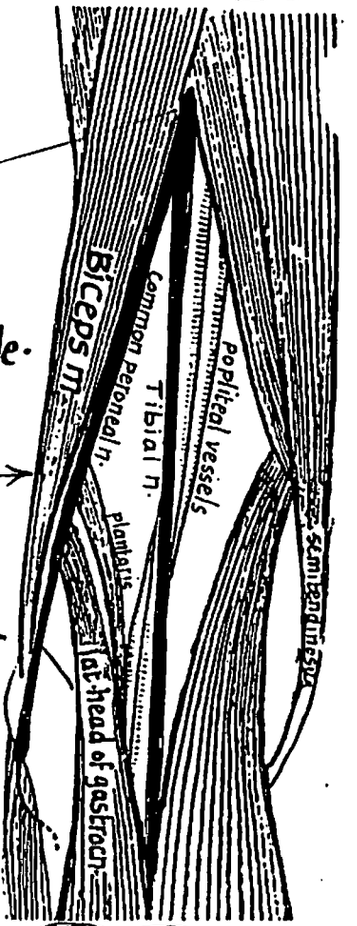
(C) Articular: to the intertarsal & tarsometatarsal joints

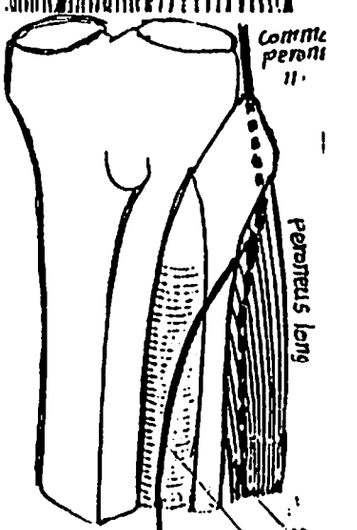
N.B: the lat. plantar n. is similar to the ulnar n. in the hand.



Common Peroneal (lat. popliteal) nerve

- **Root value**: dorsal divisions of L4,5 & S1,2
- **Origin**: arises as the smaller of the 2 terminal brs. of the sciatic n. at the lower ⅓ of the back of thigh.
- **Course & relations**:
 - it descends lat. to the tibial n. to enter the popliteal fossa at its upper angle.
 - it passes obliquely downwards & laterally in the popliteal fossa along the med. border of biceps femoris muscle.
 - it crosses over the plantaris m. & the lat. head of gastrocnemius.
 - it leaves the popliteal fossa through its lateral angle.
 - it passes behind the head of fibula then winds forwards round its neck deep to peroneus longus muscle.
- **Termination**: it ends on the lat. side of neck of fibula by dividing into:
 (1) deep peroneal (anterior tibial) nerve.
 (2) Superficial peroneal (musculocutaneous) nerve.





Branches:

(I) - **No muscular branches.**

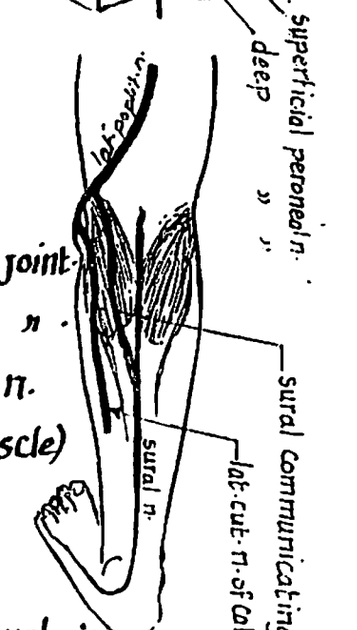
(II) - **2 cutaneous branches:**

(1) **Sural communicating n.:**
- arises near the head of fibula & runs downwards on the lat. head of gastrocnemius to join the sural n. (br. of tibial n.): see page 98

(2) **lat. cutaneous n. of Calf:**
- arises from the common peroneal n. as it leaves the popliteal fossa
- it supplies the skin of the upper lat. aspect of the leg.

(III) - **3 articular (genicular) brs.:**

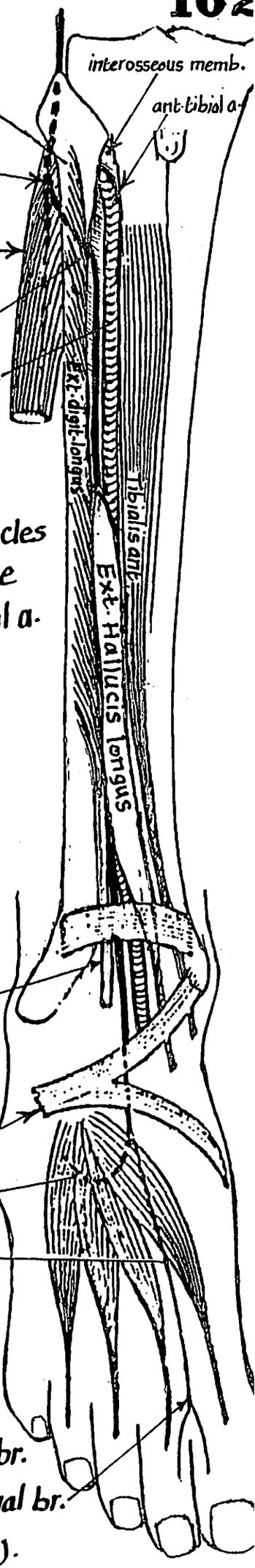
(1) Sup. lat. genicular: runs above the lat. femoral condyle to supply the knee joint.
(2) inf. " " : " below " " tibial " " " " " ".
(3) recurrent genicular n.: arises near the end of the common peroneal n. & ascends with the ant. tibial recurrent a. (through the tibialis ant. muscle) to supply the knee joint & the sup. tibiofibular joint.



Applied anatomy:

(1) Common peroneal n. is the only nerve which can be palpated subcutaneously in the L.L. (felt against neck of fibula). N.B: ulnar n. is the only n. palpated " in the U.L.

Anterior tibial (Deep peroneal) nerve



***Origin**: arises on the lat. aspect of the neck of fibula (undercover of peroneus longus m.) as one of the 2 terminal branches of the common peroneal nerve.

***Course**:

(1) at its origin it lies in the lat. compartment deep to peroneus longus
(2) it pierces the ant. intermuscular septum to enter the ant. compartment of the leg, passing deep to the uppermost part of Ext. digit. longus m.
(3) it descends vertically on the interosseous memb, in company with ant. tibial a.
(4) above the ankle, the ant. tibial n. & vessels lie on the lower part of tibia
(5) finally, the ant. tibial n. crosses infront of the ankle joint deep to the extensor retinacula.

***Relations**:

I- In the upper ⅓ of leg:
- anteriorly: skin, fascia & extensor muscles
- posteriorly: the interosseous membrane
- medially: tibialis ant. m. + ant. tibial a.
- laterally: ext. digit. longus m.

II- in the middle ⅓ of leg:
- anteriorly: skin, fascia, extensor muscles
- posteriorly: ant. tibial a. + the interosseous membrane
- medially: tibialis ant. m.
- laterally: ext. hallucis longus

III- in the lower ⅓ of leg:
- anteriorly: skin, fascia & ext. hall. longus
- posteriorly: tibia
- medially: ext. hall. longus & ant. tibial a.
- laterally: ext. digitorum longus

N.B: the ant. tibial n. has triple relation with ant. tibial a. being lat. to the a. in the upper ⅓ then ant. in the middle ⅓ then returns lat. to the artery again in the lower ⅓ of leg.

***Termination**: it ends just distal to the inf. ext. retinaculum by dividing into 2 terminal branches: lat. & med.

***Branches**:

I- Muscular: to 5 muscles:
- Tibialis ant
- ext. digit. longus
- ext. hall. longus
- peroneus tertius

(by the deep peroneal n. itself)

- ext. digit. brevis: by the lat. terminal br.

II- Cutaneous: to the cleft between 1st & 2nd toes: by the med. terminal br.

III- Articular: (1) to the ankle joint (by the deep peroneal n. itself).
(2) to the tarsal & tarsometatarsal joints (by both terminal branches).

Musculocutaneous nerve
(Superficial peroneal nerve)

Origin: arises as one of the 2 terminal branches of the common peroneal n. on the lat. side of neck of fibula (in the substance of peroneus longus muscle).

Course & relations:

1) At first, it descends in the substance of peroneus longus m.
2) then it descends between the peroneus longus & brevis muscles (supplying both).
3) At the lower 1/3 of the leg it emerges between the 2 muscles & pierces the deep fascia to become subcutaneous
4) it descends in the superficial fascia crossing superficial to the sup. & inf. extensor retinacula to reach the dorsum of the foot where it ends by dividing into med. & lat. terminal branches.

Branches of the musculocutaneous n.:

I-**Muscular**: to supply the 2 muscles of the lat. compartment of leg: (a) peroneus longus (b) peroneus brevis.

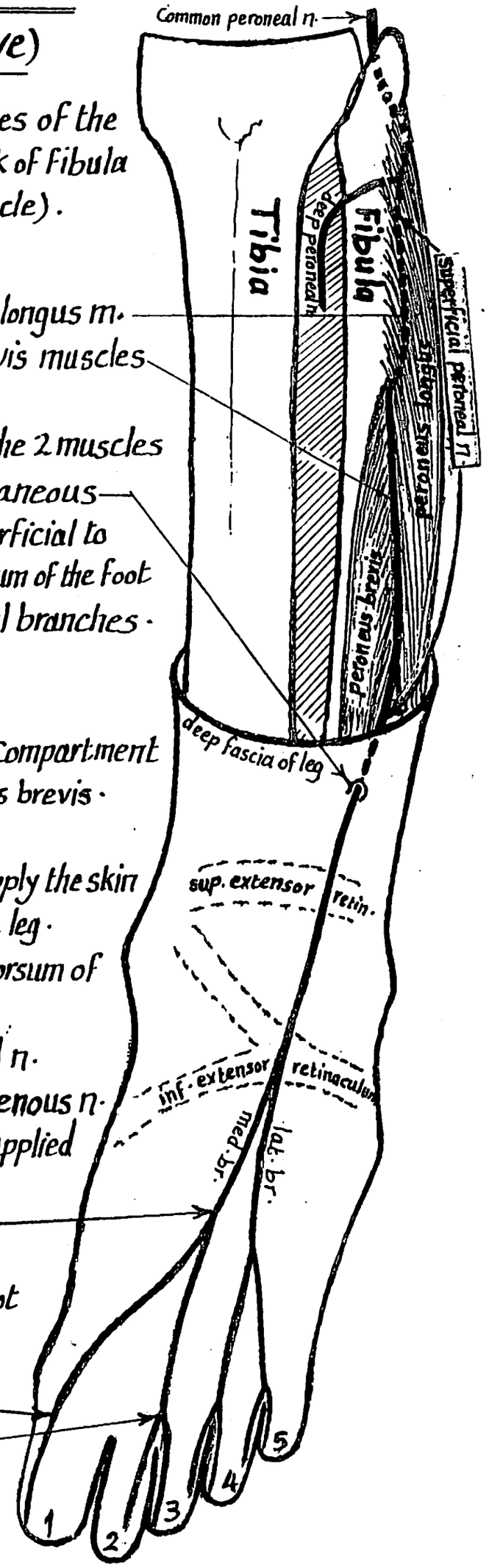
I-**Cutaneous**:

(A) cutaneous branches from the main trunk: supply the skin of the lower 2/3 of the anterolateral aspect of the leg.

(B) the lat. & med. terminal branches: supply the dorsum of the foot & toes except:
(1) the lat. border which is supplied by the Sural n.
(2) the med. border " " " " " Saphenous n.
(3) the cleft between the 1st & 2nd toes which is supplied by the ant. tibial n.

The Medial terminal branch:

Supplies the skin of the med. part of dorsum of foot then divides into 2 dorsal digital nerves:
(a) one for the med. side of the big toe
(b) one for the adjacent sides of the 2nd & 3rd toes



* The lateral terminal branch : supplies the skin of the lat. part of dorsum of foot then divides into 2 dorsal digital branches :
- one for the adjacent sides of the 3rd & 4th toes.
- one " " " " " " 4th & 5th toes.

Injury of lateral popliteal (Common peroneal) n.

* Sites & Causes : wounds in the popliteal fossa or fracture of neck of fibula.
* Effects :

I- Motor <
(1) paralysis of the muscles of the ant. compartment of the leg (extensors) as they are supplied by the ant. tibial br. of the lat. popliteal n.
(2) paralysis of the the muscles of the lat. compartment of the leg (everters) as they are supplied by the the musculocutaneous br. of the lat. popliteal n.

II- Sensory : loss of sensations from the anterolateral aspect of the leg + the dorsum of the foot (except the med. & lat. borders).

III- Deformity : foot drop (due to paralysis of the extensors of the foot) + inversion (" " " " " evertors " " ") this deformity is called **Talipus equinovarus**



Injury of the tibial n. (med. popliteal) nerve

* Sites & Causes : wounds in the popliteal fossa
* Effects :
I- Motor : <
paralysis of the superficial & deep muscles of the back of leg.
paralysis of all muscles of the sole

II- Sensory : loss of sensations from the sole of the foot

III- Deformity : dorsiflexion & eversion of the ankle of the foot. This deformity is called **Talipus Calcaneovalgus**).

Cutaneous innervation of the L.L.

(A) The thigh :

(1) skin of the groin (junctional area between abdomen & front of thigh) : is supplied by :
- (a) ilio inguinal nerve
- (b) femoral br. of genitofemoral n

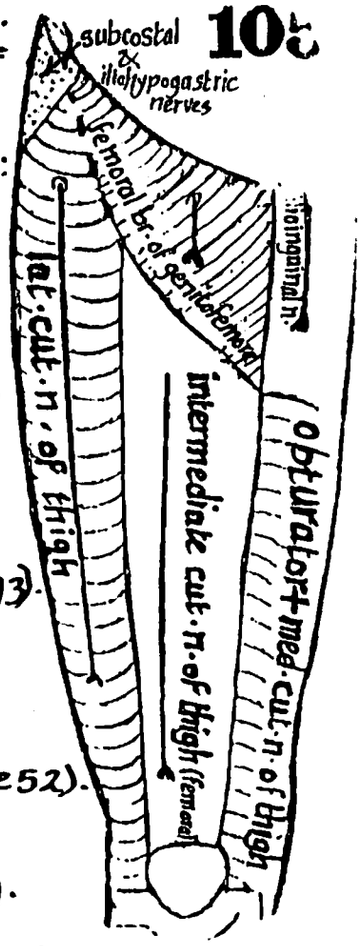
} from lumbar plexus

(2) Lat. aspect of the thigh : is supplied by the lat. cut. n. of thigh (br. from the lumbar plexus).

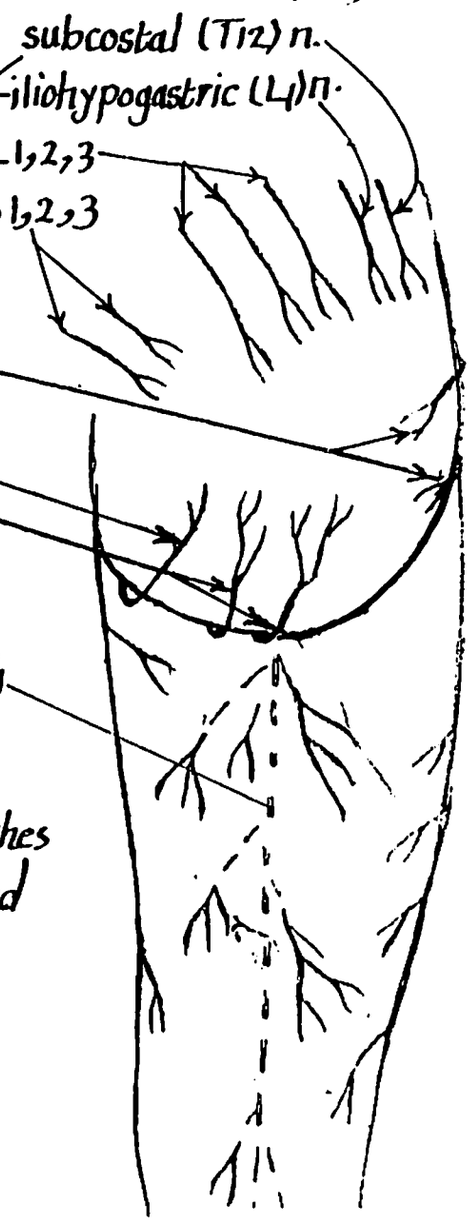
(3) Ant. aspect of the thigh : is supplied by the intermediate cut. n. of thigh (br. of femoral n.) (Page 93).

(4) Med. aspect of the thigh is supplied by :
- (a) med. cut. n. of thigh (br. from femoral n.) : page 93.
- (b) Obturator n. : through its br. to the subsartorial plexus (page 52).

(5) Skin around patella : supplied by the patellar plexus (page 93).



(6) Skin of the Gluteal region :
- (a) the upper & ant. part is supplied by the lat. cut. brs. of subcostal (T12) n. & iliohypogastric (L1) n.
- (b) " " " post. " " " " : post. 1ry rami of L1,2,3 & " " " " S1,2,3
- (c) the lower & ant. part is supplied by branches from the post. division of lat. cutaneous n. of thigh.
- (d) " " & post. part is supplied by :
 - (1) perforating cut. n. (S 2,3)
 - (2) brs. of post. cut. n of thigh (S1,2,3)



(7) Skin of the back of thigh :

it is mainly supplied by the post. cut. nerve of thigh (br. from the sacral plexus).

N.B: the skin of the front of the thigh is supplied by branches from the lumbar plexus while back of thigh is supplied by br. from the sacral plexus.

C- Skin of the leg

(1) Skin of the med. side : supplied by saphenous n. (br. from femoral n.).

(2) Skin of the antero-lateral side : is supplied by :

(a) lat. cut. n. of calf (br. from common peroneal n.)

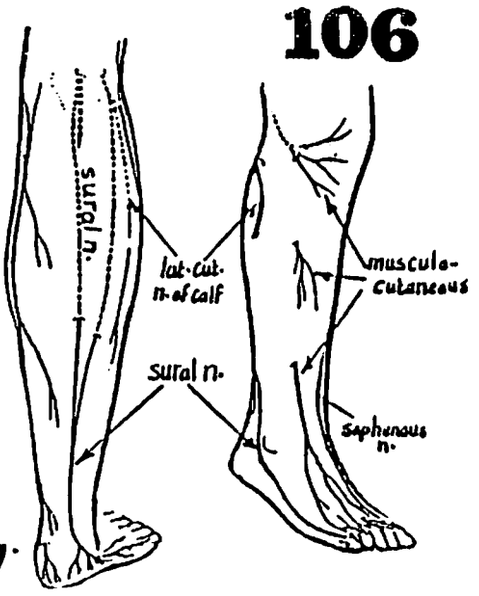
(b) the superficial peroneal (musculocutaneous) n.

(3) Skin of the back of leg : is supplied by :

(a) post. cut. n. of thigh : to the upper 1/3 of the back of leg.

(b) sural n. (from tibial n.) to lower 2/3 of back of leg.

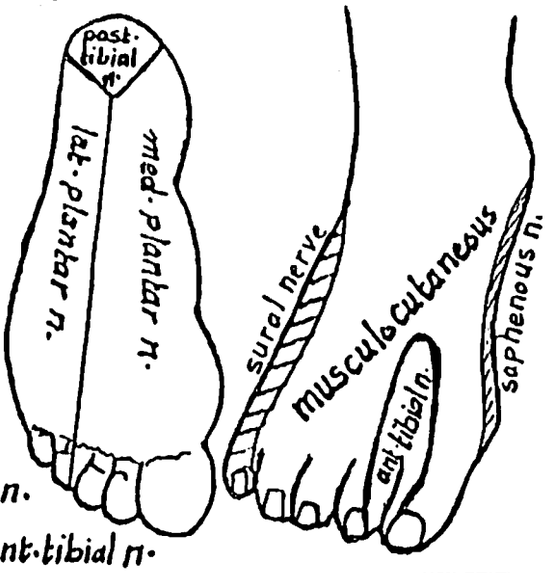
(c) lat. cut. n. of calf (from common peroneal) : to the upper part of the back & lat. side of the leg.



D- Skin of the foot :

(1) sole of the foot :
supplied by post. tibial, med. & lat. plantar nerves (for details : see pages 99 & 100).

(2) dorsum of the foot :
supplied by the musculo-cutaneous n. except
(a) the lateral border which is supplied by Sural n.
(b) " medial " " " " " Saphenous n.
(c) the cleft between the 1st & 2nd toes : supplied by ant. tibial n.



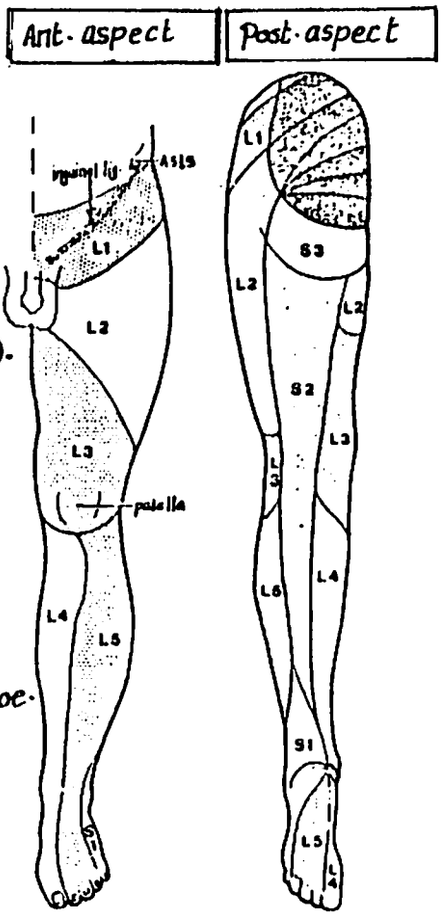
Segmental Cutaneous innervation of L.L.
(Dermatomes of the L.L.)

the skin of the L.L. is supplied by all lumbar segments & the upper 3 sacral segments of the spinal cord as follows :

* L1,2,3 supply the ant., the med. & the lat. aspects of the thigh (arranged from above downwards in the same order).
* L4 : supplies the anteromedial aspect of the leg + the medial border of the foot & the big toe.
* L5 : supplies the anterolateral aspect of the leg + the middle part of the foot & the 2nd, 3rd & 4th toes.

N.B : the ant. border of tibia separates the dermatomes of L4 & L5

* S1 : supplies the lat. aspect of the foot including the heel & the little toe.
* S2 : supplies a narrow vertical strip in the middle of the post. aspect of the thigh & leg (extending from the dermatome of S3 at the gluteal region above to the dermatome of S1 at the heel below.
* S3 : supplies the skin of the gluteal region (lower & medial part).



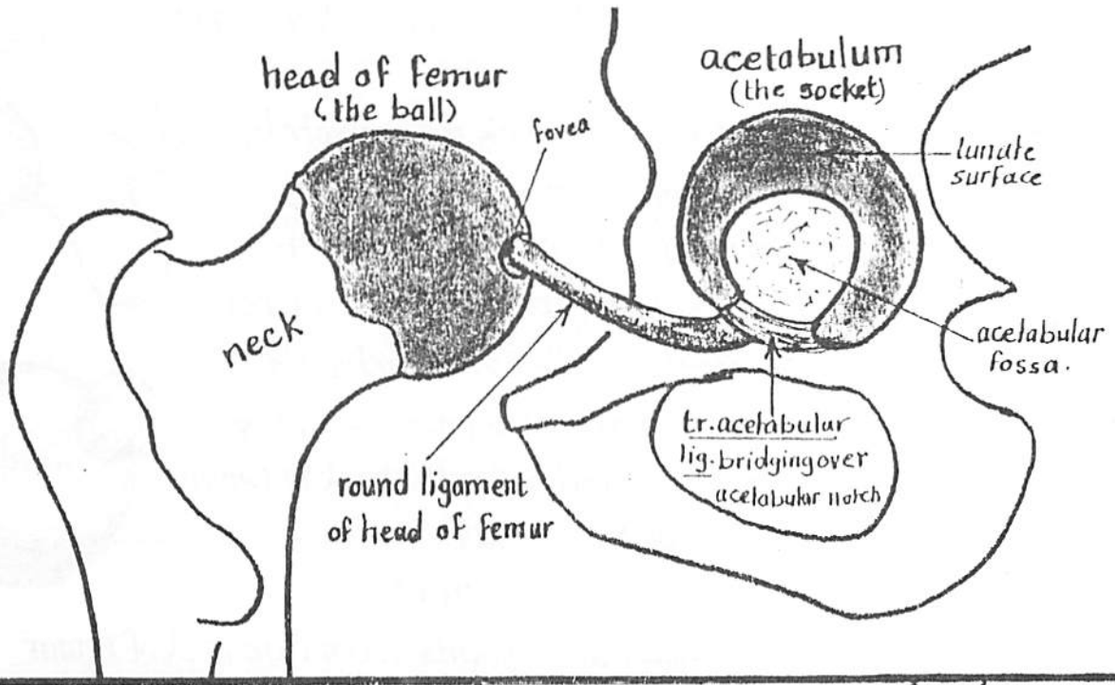
Joints of lower limb

1- Hip joint

I* **Type & variety**: Synovial, ball & Socket

II* **The articulating bones** & shape of their articular surfaces :

the head of femur (representing the ball) articulates with the acetabulum of the hip bone (representing the socket).



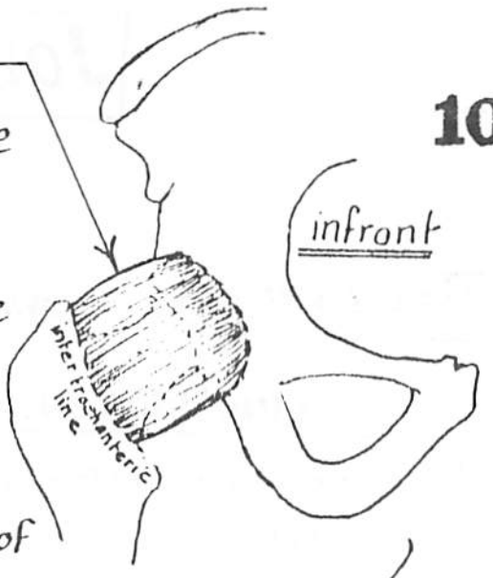
The Head of femur	The Acetabulum
* It is spherical in shape (forming about 3/5 of a sphere). * It is directed upwards, backwards & medially. * it is smooth & covered by an articular hyaline cartilage except the central depression called the fovea which gives attachment to the round ligament of the head	* it is a deep cup-shaped concavity in the lat. aspect of the hip bone. * it is directed downwards, forwards & laterally. * it has a C-shaped smooth articular surface called the lunate surface which is covered by hyaline cartilage. * its margin is deficient below forming the acetabular notch which is bridged over by the transverse acetabular lig. * a lip of fibrocartilage called labrum acetabulare is attached to its margins. * its centre shows a rough non-articular acetabular fossa.

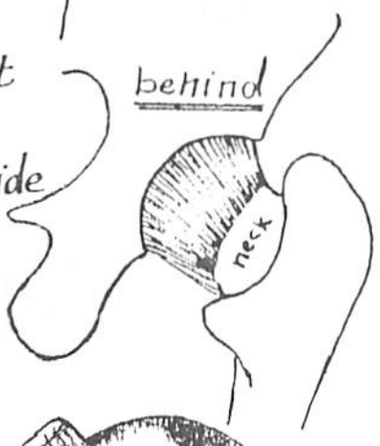
III- The Fibrous Capsule:

* It is a strong fibrous sleeve connecting the articulating bones
* **Attachments:**

(a) proximally: it is attached to the circumference of the acetabulum ½ cm outside the labrum acetabulare.

(b) distally: it is attached anteriorly to the inter-trochanteric line & posteriorly to the neck of femur ½ an inch above the intertrochanteric crest





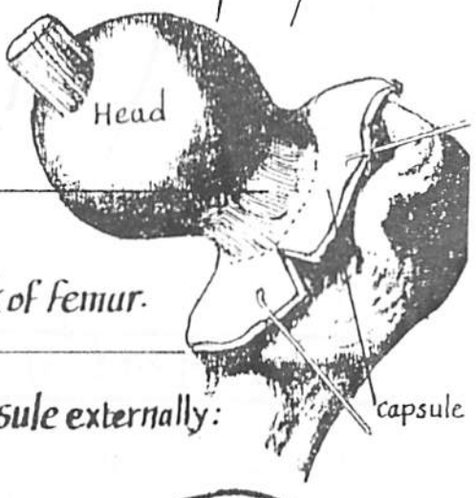
N.B:

(1) this means that anteriorly, the neck is completely inside the capsule while posteriorly only its med. ½ is intracapsular while its lat. ½ is extracapsular.

(2) the capsule is made up of two types of fibres: outer longitudinal & inner circular (called zona orbicularis)

(3) the longitudinal fibres are maximal anterosuperiorly where many of them are reflected along the neck of femur forming the retinaculae of the capsule

Functions: (1) carry blood supply to the head
(2) retain the fragmented segments in fracture neck of femur.



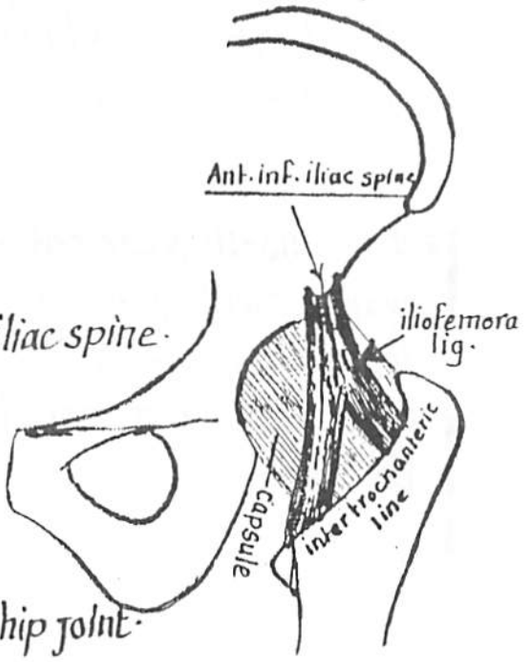
V- The Ligaments: 3 ligaments strengthen the capsule externally:

(1) the Iliofemoral ligament:

- it is the **strongest** ligament in the body (½ - 1cm thick).
- **Shape**: inverted Y-shaped having a stem & 2 limbs.
- **Site**: lies on the ant. aspect of the capsule.
- **attachments**:
 - the proximal narrow stem is attached to the ant. sup. iliac spine.
 - the distal 2 limbs are attached below to the upper & lower parts of the intertrochanteric line
- **Functions**:

(1) it strengthens the ant. aspect of the capsule

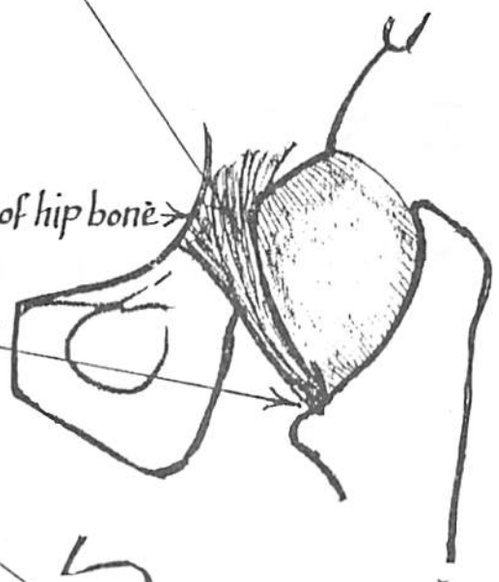
(2) it prevents hyperextension & excessive lat. rotation of hip joint.



N.B: there is a tendency for hyperextension to occur in the hip joint as the line of the of body weight passes behind the centre of the joint.

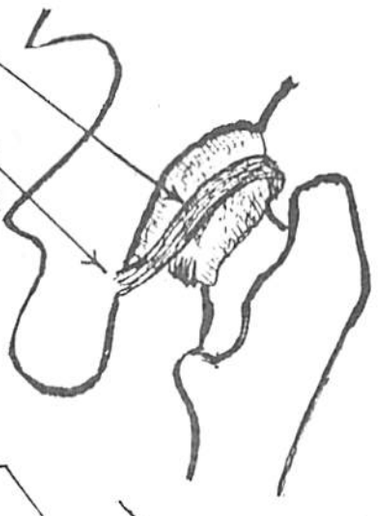
(2) Pubofemoral ligament :

* Shape : triangular
* Site : lies on the inferomedial aspect of the capsule
* attachments :
 - its proximal part or base is attached to the iliopubic eminence of hip bone
 - its distal end or apex is attached to the neck of femur just above & infront of the lesser trochanter
* Functions : (1) strengthens the inferomed. aspect of the capsule.
 (2) prevents over abduction of the hip joint.



(3) Ischiofemoral ligament :

* it is the weakest lig. & lies on the back of the hip joint.
* it arises from the posteroinferior margin of the acetabulum.
* its fibres pass upwards & laterally twisting around the capsule & blending with it forming the zona orbicularis
* Function : it screws the femoral head medially into the acetabulum, preventing hyperextension of the hip.

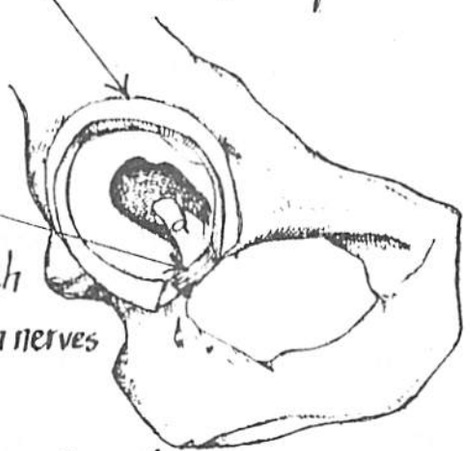


(4) Labrum acetabulare :

* it is a ring of fibrocartilage fixed to rim of the acetabulum to deepen its cavity.

(5) Transverse acetabular ligament :

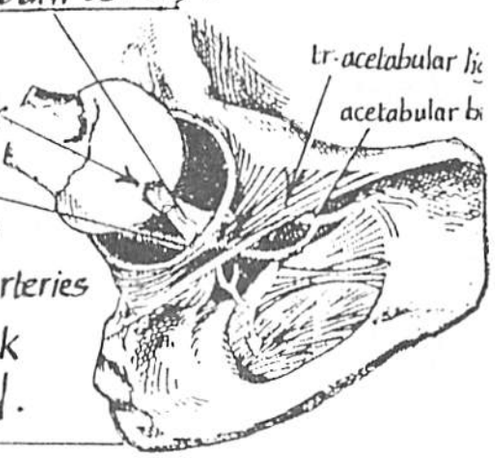
* it is a strong fibrous band bridging over the acetabular notch
* it converts the acetabular notch into foramen through which nerves & blood vessels pass to the round lig. of the head of femur



(6) Ligament of head of femur (round lig. or ligamentum teres) :

* it is a triangular flat ligament
* its apex is attached to the pit or fovea of the head of femur
* its base " " " " transverse acetabular lig.
* Function : it transmits arteries to the head of femur (from the acetabular branches of obturator & med. circumflex femoral arteries

N.B : it has no role in stabilizing the joint because it is weak & becomes tense only when the thigh is flexed & adducted.



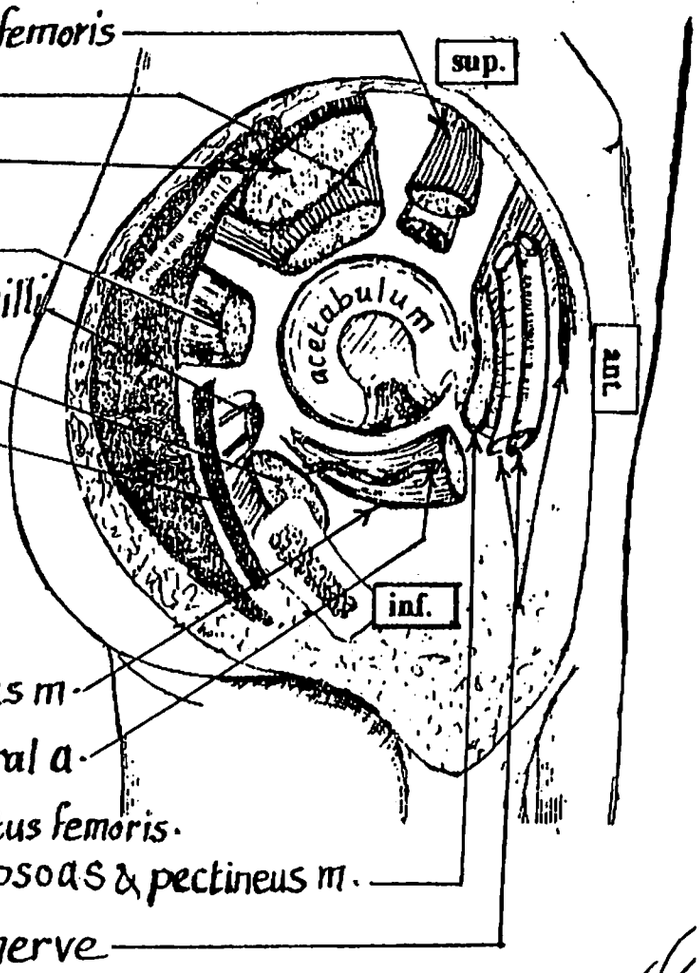
V- The Synovial membrane : it lines the fibrous capsule, intracapsular portion of the neck of femur, labrum acetabulare, transverse acetabular lig., fat in the acetabular fossa & also invests the round lig. of the head of femur.

VI- Intra capsular structures :

(1) labrum acetabulare (2) transverse acetabular lig. (3) ligamentum teres

VII- Relations of the hip joint :

* **Superiorly :**
 - reflected head of rectus femoris
 - gluteus minimus
 - gluteus medius
* **posteriorly**
 - piriformis
 - obt. internus & both gemilli
 - quadratus femoris
 - sciatic nerve
* **Laterally**
 - gluteus medius
 - gluteus minimus
 - tensor fascia lata
* **Inferiorly**
 - obturator externus m.
 - med. circumflex femoral a.
* **Anteriorly**
 - Straight head of rectus femoris.
 - psoas bursa & iliopsoas & pectineus m.
 - femoral vessels & nerve



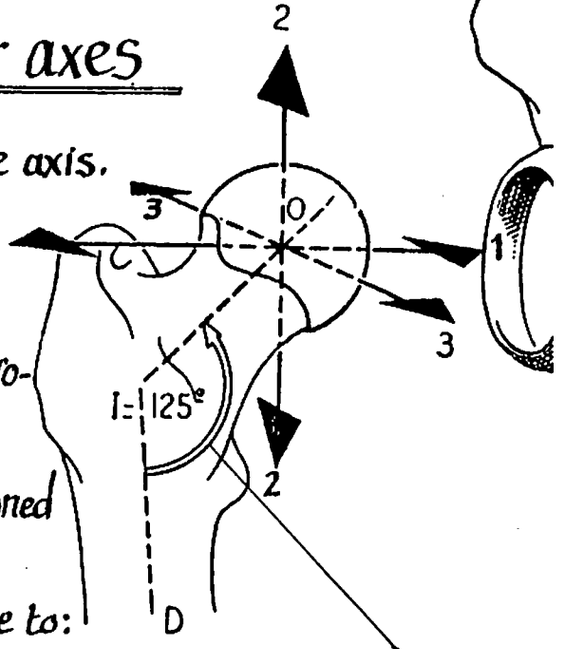
Movements allowed & their axes

(1) **Flexion & extension** : occur around a transverse axis.

(2) **Medial & lateral rotation** : occur around a vertical axis.

(3) **Abduction & adduction** : occur around an antero-posterior axis.

(4) **Circumduction** : is a combination of the abovementioned movements.



N.B : the wide range of movements of the hip joint is due to:

(a) the presence of angle between the neck & shaft of femur (neck-shaft angle)

(b) the length of the femur.

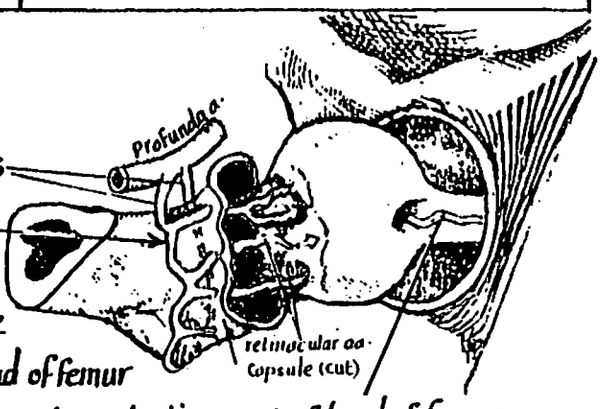
(c) the neck of femur is narrow than the head this allows a considerable movement before the head impinges on labrum acetabulare.

* Muscles producing movements in the hip joint:

	Movement	Chief muscles responsible	Accessory muscles helping
1-	Flexion	iliopsoas (psoas major + iliacus)	- pectineus, rectus femoris & sartorius. - Adductors (mainly adductor longus.
2-	Extension	- gluteus maximus: during standing from sitting position, running & climbing upstairs. - hamstrings: on walking on a level	
3-	Abduction	- Gluteus medius & minimus.	- Tensor fascia latae & Sartorius
4-	Adduction	- Adductors (longus, brevis & magnus).	- pectineus & gracilis.
5-	Med. rotation	- ant. fibres of glutei medius & minimus	
6-	Lat. rotation	- the 6 lateral rotators	- gluteus maximus & sartorius

* Blood Supply of the hip joint:

(a) medial & lateral circumflex femoral arteries (branches of profunda a.) form an arterial circle around the capsular attachment on the neck of femur. Retinacular arteries arise from this circle and supply the intracapsular part of the neck & the greater part of the head of femur



(b) a small part of the head is supplied by arteries passing along the ligament of head of femur (derived from the acetabular brs. of obturator & med. circumflex femoral arteries).

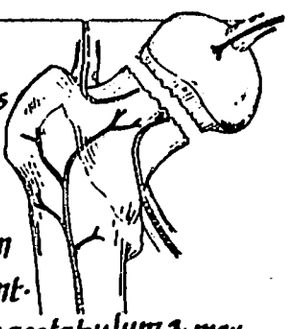
* Nerve Supply

(1) femoral n., through the nerve to rectus femoris.
(2) ant. division of obturator n. (3) Sciatic n. (4) n. to quadratus femoris.

* Stability of the hip joint: it is very stable joint due to the following factors:

(1) Bony factor: the spherical head of femur fits well in the deep acetabulum.
(2) Ligamentous factor: the capsule is strong & is reinforced by very strong ligaments, especially the iliofemoral lig.
(3) Muscular factor: the joint is surrounded all around by strong muscles.

Applied anatomy



(1) Fracture of femoral neck: common in old persons (especially women) due to osteoporosis. It is commonly intracapsular. High fracture of the neck leads to cutting the blood supply of the head of femur (page 10) → Avascular necrosis of the head.
(2) Dislocation of the hip joint: may be: (a) Congenital: the head of femur slips upwards on to the gluteal surface of ilium because the upper margin of acetabulum is congenitally deficient.
(b) acquired: commonly post-dislocation occuring in car accidents forcing the head out of the acetabulum & may lead to injury of the sciatic nerve.
(3) Coxa vara: abnormal decrease in the neck-shaft angle causing mild shortening of the lower limb.
(4) Coxa valga: " increase " " " " " " " lenghening " " " "

Knee Joint

I-Type & variety : Synovial Condyloid (modified hinge) because it allows some med. & lat. rotation in addition to flexion & extension occuring in the classical hinge joint

II-Articular Surfaces of the bones forming the joint :

the articulating bones include :

(1) the lower end of femur.

(2) " upper " " tibia.

(3) " posterior surface of the patella.

the joint consists of 3 articulations :

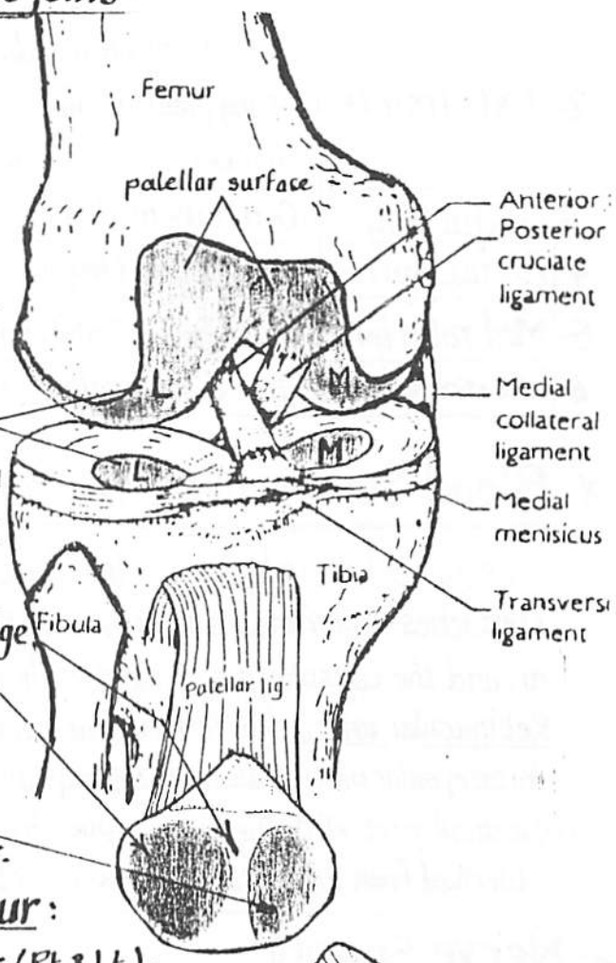
(1) Femoro patellar articulation between patellar surface of lower end of femur & the post. surface of patella

(2) lateral femoro tibial articulation between the lat. condyle of femur & lat. condyle of tibia

(3) medial femoro tibial articulation : between the med. condyle of femur & med. condyle of tibia.

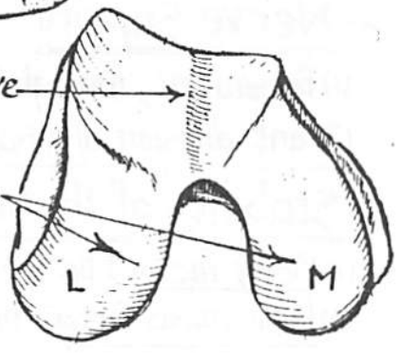
(4) the post. surface of patella is divided by vertical ridge into: (a) a large lateral articular area : for patellar surface of lat. condyle of femur:

(b) a smaller medial articular area : for patellar surface of the med. condyle of femur.



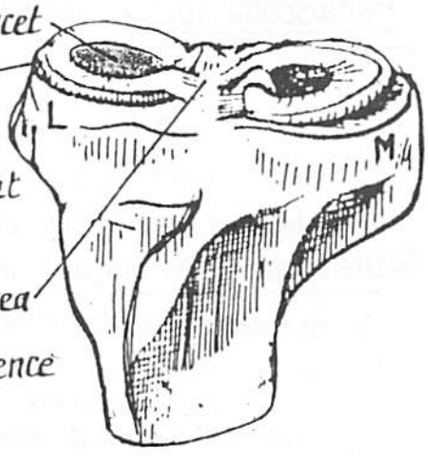
* the articular surface of the lower end of femur :

- it is inverted Y-shaped having a stem & 2 limbs (Rt. & Lt.).
- the stem of the Y represents the patellar surface & divided by a groove into a larger lat. part & a smaller med. part
- the 2 limbs of the Y represent the articular surfaces of the 2 condyles of femur, each of them is convex, covering the inf. & post. surfaces of the femoral condyles (for details see page 12)



* the articular surface of upper end of tibia :

- the upper surface of the lat. condyle shows circular articular facet which is deepened by the attachment of the lat. meniscus to its periphery.
- the upper surface of the med. condyle shows an oval articular facet which is deepened by the attachment of the med. meniscus
- the 2 condylar articular surfaces are separated by intercondylar area which is divided into ant. & post. parts by the intercondylar eminence (for details see page 19).



III- Fibrous Capsule :

- **Characters :**

(a) it is thin & deficient anteriorly where it is replaced by the quadriceps tendon, patella, patellar lig

(b) it is strengthened by expansions from the surrounding muscles : (1) semimembranosus (posteriorly) 2- vastus lateralis & iliotibial tract (laterally) 3- vastus medialis (medially)

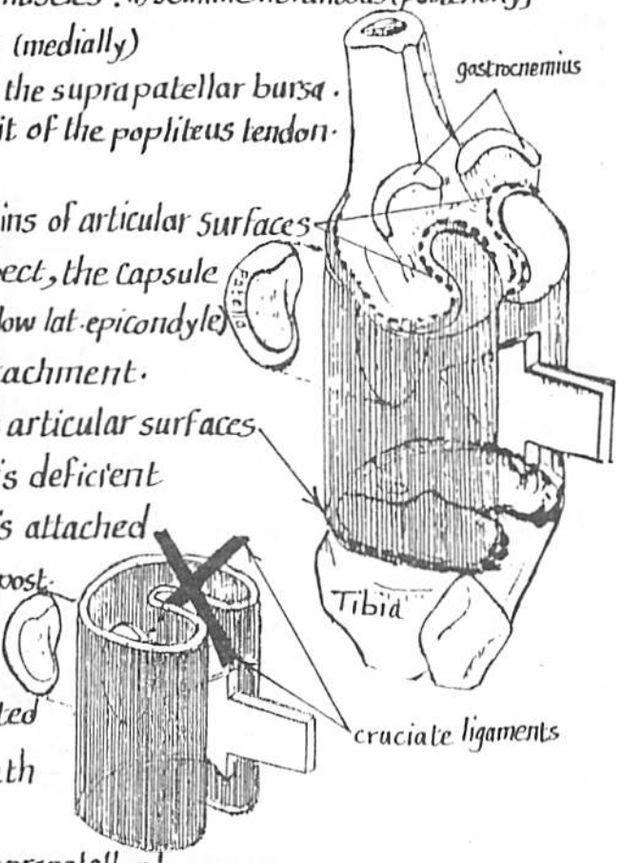
(C) it has 2 perforations : (1) one anterosuperiorly : for the suprapatellar bursa. (2) " posteriorly : for the exit of the popliteus tendon.

- **Attachments :**

(A) Femoral attachment : it is attached ½ cm beyond margins of articular surfaces of the 2 femoral condyles (except infront). on the lat. aspect, the capsule is attached just above the groove for popliteus (just below lat. epicondyle)

N.B : the med. & lat. epicondyles lie outside the capsular attachment.

(B) Tibial attachment : it is attached ½ cm beyond the articular surfaces of the tibial condyles except (1) anteriorly where it is deficient (attached to the patellar lig.) (2) posteriorly where it is attached to the intercondylar ridge which limits the attachment of the post. cruciate lig.

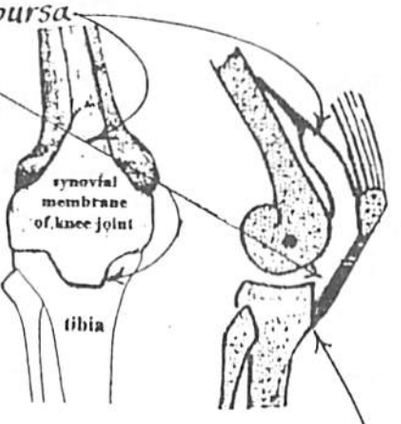


Synovial membrane :

it lines the capsule except posteriorly where it is reflected by the cruciate ligaments forwards forming common sheath for both ligaments.

Anteriorly, it extends upwards above the patella forming suprapatellar bursa

Below the patella, it covers the deep surface of infrapatellar pad of fat. forming the infrapatellar fold whose sides extend laterally forming the alar folds



IV- Ligaments of the knee joint :

(A) Extracapsular : one on each side : tibial & fibular collateral ligs. ; one infront : the patellar lig. ; one behind : oblique popliteal lig.

(B) Intracapsular : 2 cruciate ligaments : ant. & post. ; 2 semilunar cartilages (menisci) : med. & lat. ; transverse ligament of the knee. ; coronary ligaments :

(1) **patellar ligament** : about 3" long, connecting the apex of the patella to the tibial tuberosity

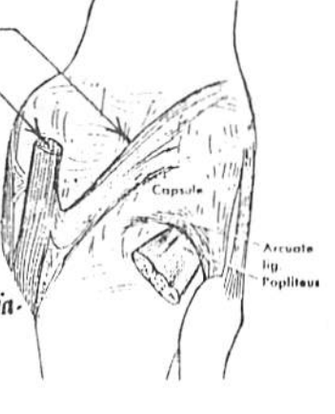
(2) **Oblique popliteal ligament** :

it is an expansion of the tendon of semimembranosus muscle

it runs upwards & laterally to be attached to the intercondylar line & lat. condyle of femur

it strengthens the capsule posteriorly & prevents hyperextension of the knee joint

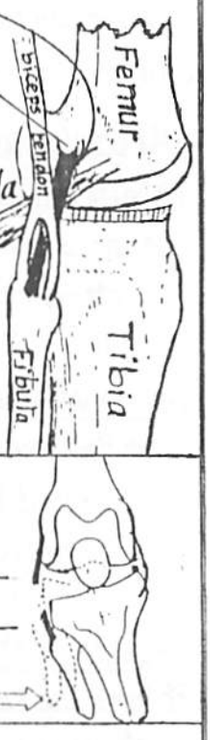
N.B : the arcuate popliteal lig. is arched fibres of the capsule over the tendon of popliteus. It is attached to the head of fibula & the post. intercondylar area of tibia.



Collateral Ligaments

Medial (tibial) collateral lig.	Lateral (fibular) collateral lig.
*Shape : strong flat triangular band.	* it is a strong rounded cord
*Attachments : - above : it is attached to med. epicondyle - below : it divides into ant. & post. parts (a) ant. (superficial) part : attached to the the upper part of med. surface of tibia behind S.G.S tendons & separated from them by bursa (b) post. (deep) part : attached to the med. condyle of tibia	*Attachments : - above : it is attached to lat. epicondyle - below : it is embraced by biceps tendon then becomes attached to head of fibula - it is related to 2 tendons (a) popliteus tendon (deeply) separating it from lat. meniscus (b) biceps tendon (superficially)
*Its deep part is firmly attached to the capsule & the med. meniscus	*It is not adherent to either the capsule or the lat. meniscus
*becomes tense in extension	*becomes tense in extension also
*may be torn in violent abduction of the leg.	* may be torn in violent adduction of the leg.
*Both ligaments contribute to the side to side stability of the knee joint	





*Intracapsular structures :

- menisci (med. & lat.)
- cruciate ligaments (ant. & post.)
- coronary ligaments.
- transeverse lig. of the knee.
- tendon of popliteus m.

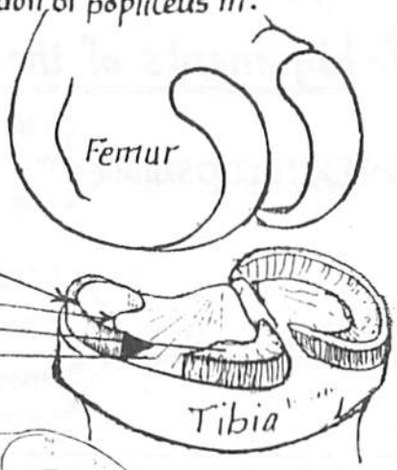
(1) Med. & Lateral semilunar cartilages (menisci) :

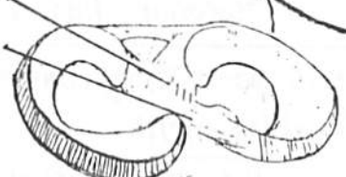
each meniscus is a curved plate of fibrocartilage which lies on the upper surface of the corresponding condyle of tibia.

each meniscus has :

(a) outer border : thick, convex & fixed to the capsule.
(b) inner border : thin, concave & free.
(c) upper surface is concave for the femur
(d) lower surface : flat & applied on the peripheral 2/3 of tibial condyle
(e) ant. horn : attached to the ant. intercondylar area
(f) post. " : " " " post. " " "

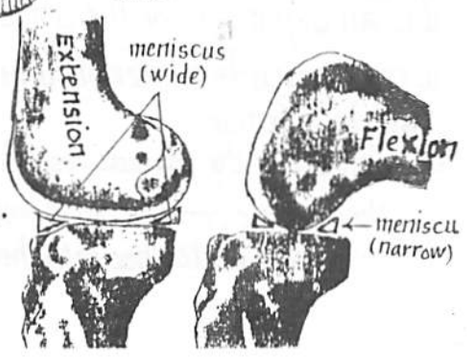
N.B : the menisci are not covered by synovial membrane.



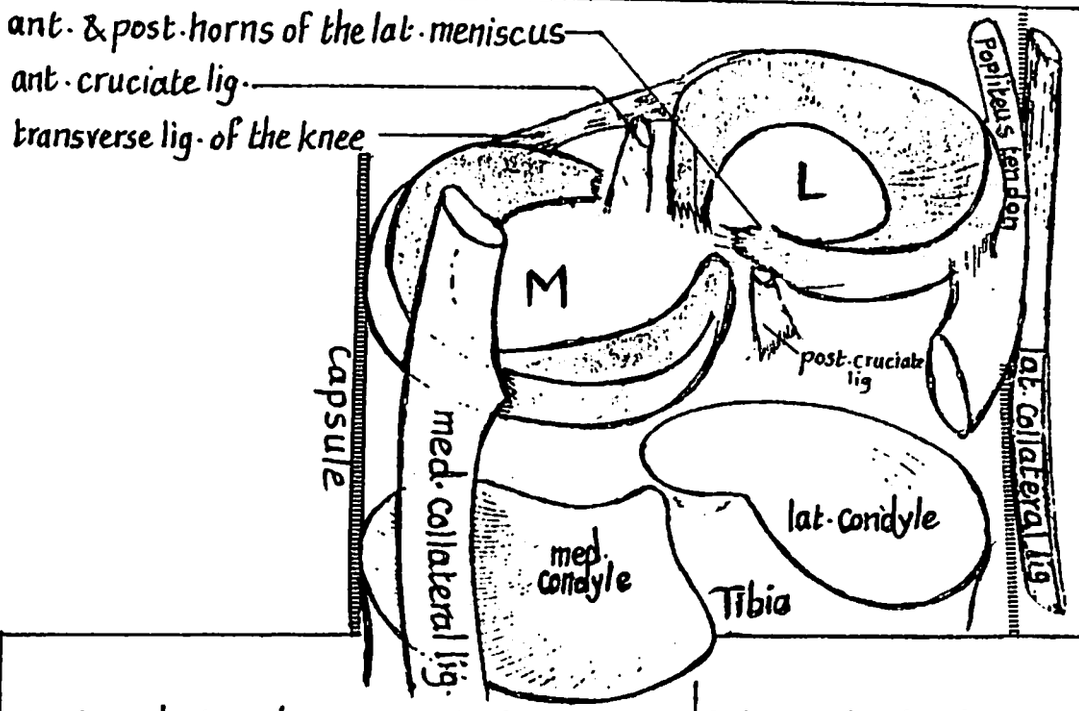


* Functions of the menisci :

(1) they deepen the articular surfaces of the tibial condyles.
(2) they are essential for rotatory movements of the knee (they move with the femur on the tibia).
(3) they adapt their contours to the varying curvature of the different parts of femoral condyles allowing gentle femoro-tibial contact in all positions.
(4) they act as shock absorbers.



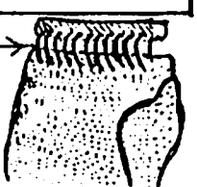
Medial Meniscus	Lateral Meniscus



	Medial Meniscus	Lateral Meniscus
Shape	C-shaped & broader posteriorly than anteriorly.	it is nearly circular & smaller than med. meniscus
Attachments	* its ant. horn is attached to the most ant. part of the ant. intercondylar area. * its post. horn is attached to the post. intercondylar area just infront of post. cruciate lig.	* its ant. horn is attached just infront of the intercondylar eminence. * its post. horn is attached just behind the intercondylar eminence.
Mobility	it is more fixed being adherent to the deep part of of the tibial collateral lig. & to the fibrous capsule	* it is more mobile being separated from the capsule & fibular collateral lig. by the popliteus tendon which is attached to the lat. meniscus controlling its mobility
Injury	being more fixed, it cannot adapt itself to sudden rotatory movements of the lower end of femur so it is more liable to injury (20 times more than the lat. meniscus	being more mobile, it can adapt itself to sudden rotatory movements so it is less liable to injury than the med. meniscus



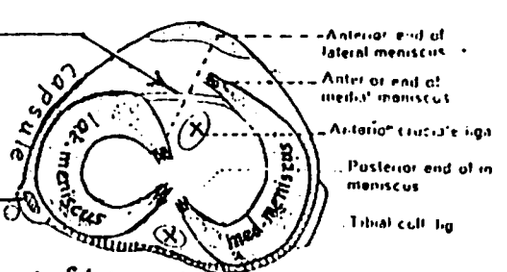
The coronary ligaments :



- the fibrous capsule is attached to the periphery of the menisci. The capsular fibres that attach the margins of the menisci to the tibial condyle is called coronary ligament.

Transverse lig. of the knee :

it connects the ant. ends of both menisci thus coordinates their movements.



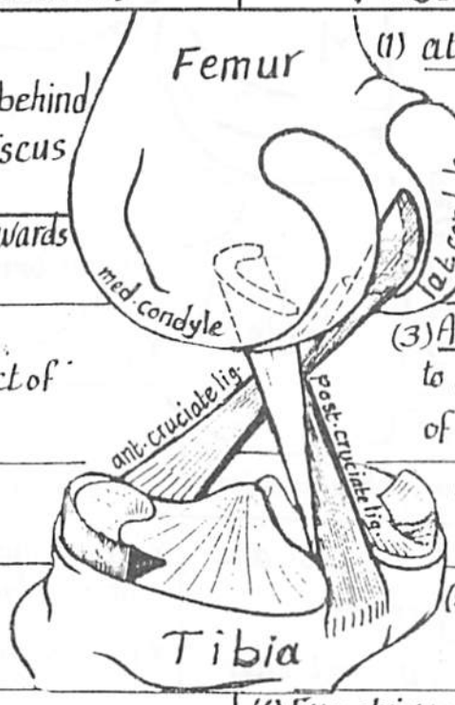
Popliteus tendon :

it is intracapsular extrasynovial. It is attached to the post. part of lat. meniscus.

Cruciate Ligaments

* They are 2 strong thick fibrous bands (ant. & post.) arranged like the limbs of the letter X inside the knee joint connecting femur & tibia.
* They are named ant. & post. according to their attachment to the tibia.

Ant. cruciate ligament	Post. cruciate ligament
(1) attachment to tibia: to the ant. intercondylar area behind the ant. horn of the med. meniscus	(1) attachment to tibia: to the most post. part of the post. intercondylar area behind the post. horn of the med. meniscus.
(2) Course: runs upwards, backwards & laterally, twisting on itself	(2) Course: runs upwards, forwards & medially, twisting on itself.
(3) attachment to the femur: to the post. part of inner aspect of lat. condyle of femur	(3) Attachment to femur: to the ant. part of the inner surface of the med. condyle of femur.
(4) it is stretched in extension of the knee.	(4) it is stretched in flexion of the knee.
(5) it is weaker than the post. cruciate lig.	(5) it is stronger than the ant. cruciate lig.
(6) Function: (a) it limits hyperextension of the knee (b) it prevents post. displacemen of femur on tibia	(6) Function: it prevents ant. dislocation of femur on tibia.



Bursae around the knee:

(A) On the ant. aspect (4 bursae):

(1) Suprapatellar bursa: it is an upward extension of the synovial membrane. It lies between lower part of quadriceps femoris & the lower part of femur

(2) prepatellar bursa: infront of patella

(3) deep infrapatellar bursa: between patellar lig. & the upper end of the tibia

(4) subcutaneous infrapatellar bursa: between the skin & tibial tuberosity

(B) On the posteromedial aspect (3 bursae):

(1) bursa between the capsule & the med. head of gastrocnemius

(2) " " " " " semimembranosus tendon

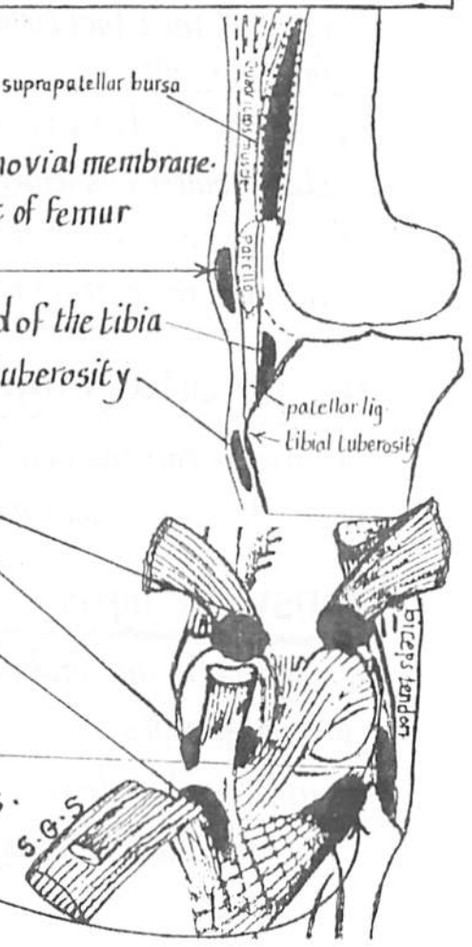
(3) " " the med. lig. of the knee & the tendons of S.G.S.

(C) On the posterolateral aspect (3 bursae)

(1) bursa between biceps tendon & fibular collateral ligament.

(2) " between the capsule & the lat. head of gastrocnemius.

(3) " " " popliteus tendon & lat. condyle of tibia



*Relations of the knee joint:

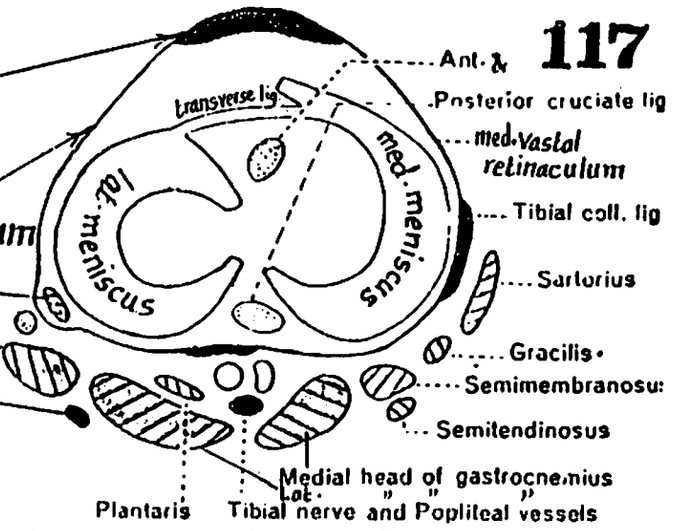
A-Anteriorly: (1) patellar lig. (2) anterior bursae

B-Anterolaterally: lateral vastal retinaculum

C-Posterolaterally: popliteus tendon, biceps tendon, common peroneal n.

D-Posteriorly: popliteal vessels & L.Ns, tibial n., semitendinosus, semimembranosus, gastrocnemius & plantaris.

E-Medially: sartorius, tibial collateral lig. & med. vastal retinaculum.



*Blood Supply of knee joint: anastomosis around the knee joint (p.79).

*Nerve Supply:

(1) Femoral n.: through its branches to vasti, especilly vastus medialis.

(2) Sciatic n.: through the genicular brs. of tibial & common peroneal nerves.

(3) Obturator n. " its post. division.

Movements allowed & Muscles responsible

Movements	Muscles responsible
1-Flexion	- main muscles: hamstrings (biceps, semitendinosus & semimembranosus). - helped by: sartorius, gracilis, gastrocnemius, popliteus & plantaris.
2-Extension	- by quadriceps femoris. - helped by tensor fascia latae m.
3-Medial rotation	- Popliteus: produces med. rotation of tibia at the beginning of Flexion (unlocks the knee) - S-G-S & semimembranosus produce med. rotation of the flexed knee.
4-lat. rotation	biceps femoris (when the knee in flexion).

N.B (1) Flexion & extension occur in the upper compartment of the joint (above the menisci).

(2) rotatory movements " " " lower " " " " (below " ").

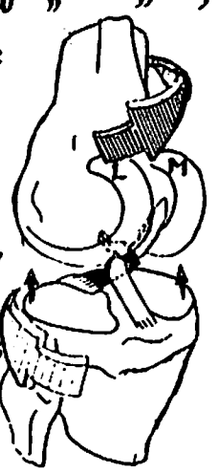
(3) Locking & unlocking of the knee (conjunct-rotation):

(A) Locking (غلق - قفل) of the knee occurs by the following meckanism:

(1) as the knee moves into full extension, the ant. cruciate lig. becomes tight thus terminating the movement (extension) of the lat. condyle of femur

(2) the med. condyle of femur continues movement (while the lat. condyle has stopped), this leads to passive med. rotation of femur (lat. rotation of tibia).

(3) this rotation which occurs at the end of extension leads to tightening of the ligaments of the joint (mainly the collateral & cruciate ligaments) makes the joint rigid i.e locked.





(B) **Unlocking** : to begin flexion, the popliteus m. produces lat. rotation of femur on tibia (when the feet are supporting the body weight) this leads to untwisting of the tight ligaments → movement can occur i.e **unlocking**. The unlocked knee can further flex by the hamstrings

*Stability of the knee joint :

it is a very stable joint due to the following factors :

(1) **Bony factors** : the intercondylar eminence of the tibia projects into the intercondylar notch of femur preventing side-to-side dislocation.

(2) **Ligamentous factors** :

(a) cruciate ligaments are essential for anteroposterior stability in flexion

(b) collateral ligaments & the oblique popliteal lig. are responsible for side-to-side stability & stability in extension.

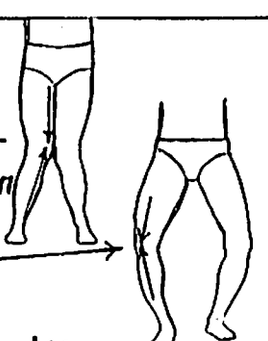
(3) **Muscular factors** :

(a) the joint is surrounded by strong muscles.

(b) the med. & lat. vastal retinacula stabilize the patella.

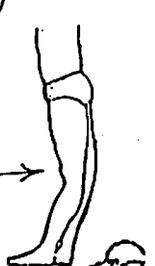
(c) the iliotibial tract stabilizes the slightly flexed knee.

Applied Anatomy



(1) **Genu Valgum** or knock knee : the leg is abnormally abducted leading to increase compression on the lat. condyle of femur & the lat. meniscus.

(2) **Genu Varum** (bow legs) : the leg is abnormally adducted leading to increase compressive forces on the med. condyle of femur & the med. meniscus.

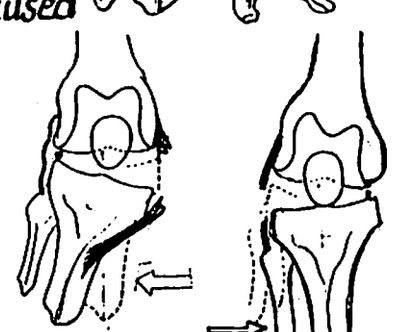


(3) **Genu recurvatum** : it is hyperextension of the knee



(4) **Injury to menisci** : is commonly due to twisting strains in a slightly flexed knee as in football players. The med. meniscus is more vulnerable to injury than the lat. (see page 115).

(5) **Injury of collateral ligaments** is less common & may be caused by severe abduction or adduction strains.



Superior Tibiofibular Joint

I- Type :- synovial Variety :- plane

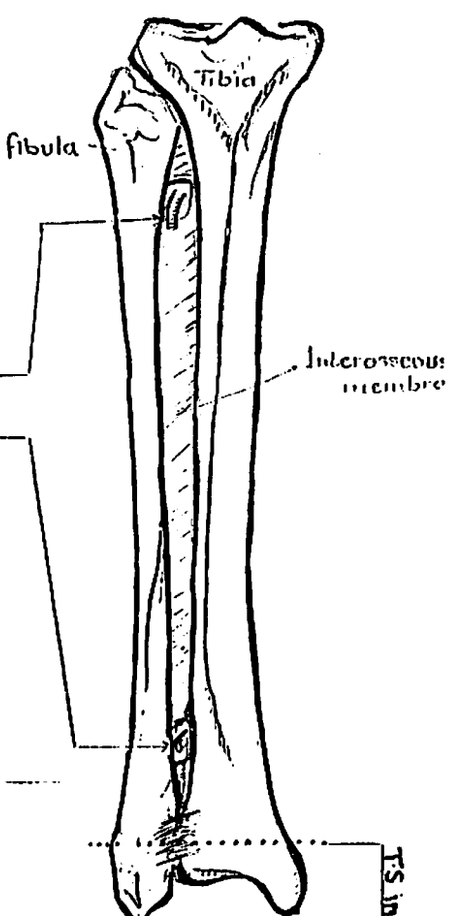
II- Bony articular surfaces :- fibular facet of tibia (on post. lat. aspect of lat. condyle)
articular facet of head of fibula

III- Capsule & ligaments : The capsule is attached around the margins of the articular surfaces & strengthened by ant. & post. tibiofibular ligame

IV- Movements allowed : Sliding movements

Interosseous membrane between Tibia & Fibula

* It is considered as Fibrous Joint (syndysmosis)
* Attachment :- It connects the interosseous borders of Tibia & Fibula.
* Direction of fibres :- Downwards & Laterally from Tibia to Fibula.
* Structures peircing it :-
 1] Near its upper end : It is pierced by ant. tibial vessels
 2] Near its lower end : It is pierced by perforating br. of peroneal artery.
* Muscles arising from it :-
 - Anteriorly :- 4 muscles
 (1) Tibialis ant. (2] Ext. digitorum longus
 (3) Ext. hallucis longus (4) Peroneus tertius
 - Posteriorly :- Only one muscle : Tibialis posterior



Inferior Tibio-Fibular Joint

I- Type & Variety :- Fibrous , syndysmosis

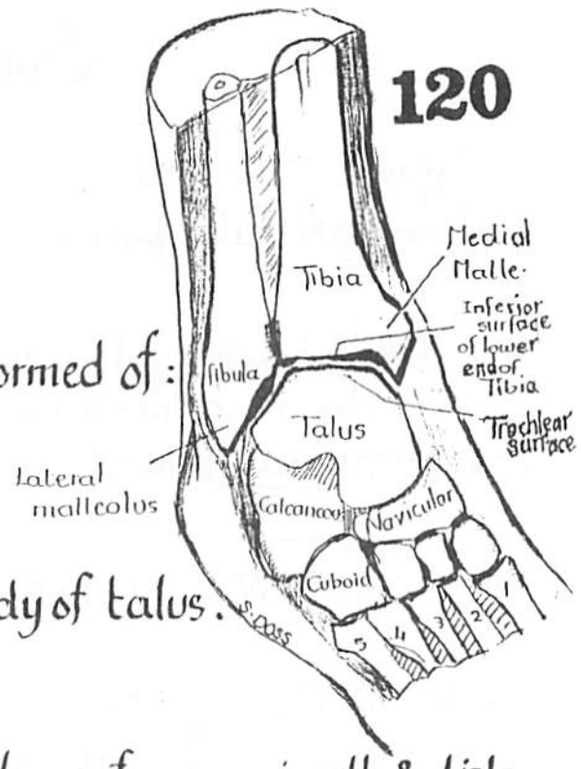
II- Articulating bones : (1) Fibular notch of lower end of tibia
(2) The med. surface of lower end of fibula (rough area)

III- Ligaments :-
1] Interosseous Tibio-fibular lig. :- a very strong lig. filling gap between articular surfaces
2] Anterior Tibio-fibular lig.
3] Posterior Tibio-fibular lig.

IV- Movements :- It is an immobile joint to prevent the seperation of the 2 bones under the effect of body weight

Ankle Joint

I- Type & Variety : synovial , hinge



II- Articular surfaces :

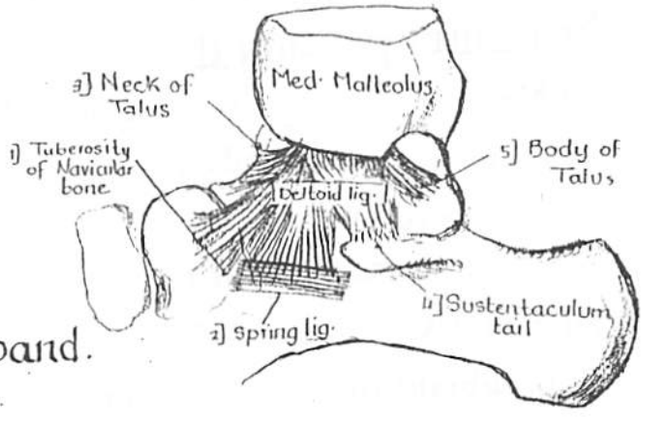
[1] Proximally : The articular surface is formed of :
- a] Inferior surface of lower end of tibia
- b] Lateral surface of the med· malleolus
- c] Medial surface of the lat· malleolus

[2] Distally : The trochlear surface of body of talus.

III- Fibrous capsule :

* It is attached to the margins of the articular surfaces proximally & dista
* It is weak infront & behind but thick medially & laterally being strengthened by collateral ligaments (like all hinge Joints).

IV- Ligaments :



The medial lig· of ankle (Deltoid lig·) :

* It is one of the strongest ligaments in the body (next to the iliofemoral & interosseous sarcoiliac ligaments).
* Shape : It is broad , thick triangular band.
* Attachments :
 - (a) Superiorly : attached by its apex to the tip , ant· & post· borders of med· ma
 - (b) Inferiorly : attached by its base to the following structures (from before backwards)
 - (1) Tuberosity of Navicular bone .
 - (2) Medial border of spring lig· (Plantar Calcaneonavicular lig·).
 - (3) The neck of talus.
 - (4) The sustentaculum tali·
 - (5) The body of talus.
* Its attachment to the spring lig· helps to maintain the medial longitud arch of foot by supporting the head of talus (See Arches of foot p 127)
* N·B : The strength of the deltoid lig· compensates for the shortness of the medial malleolus .

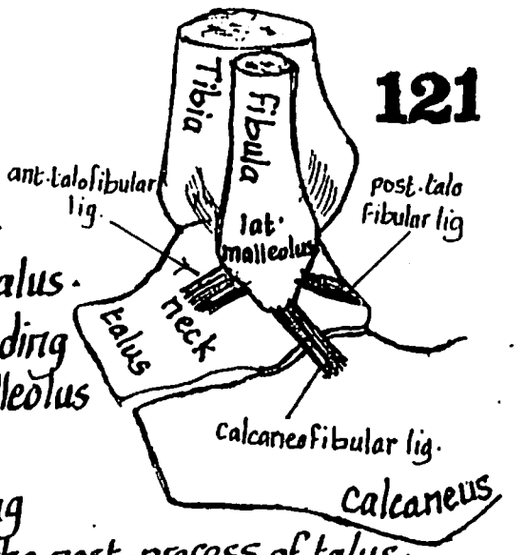
(2) The Lateral ligament of ankle :

is formed of 3 separate bands :

(a) the ant. talofibular lig. : extends from the lat. malleolus to the neck of talus.

(b) » Calcaneofibular lig. : is a stronger band extending downwards & backwards from the tip of lat. malleolus to the lat. surface of Calcaneus.

(c) » post. talofibular lig. : is a strong band extending from the malleolar fossa medially to be attached to the post. process of talus.



V Relations of Ankle joint :

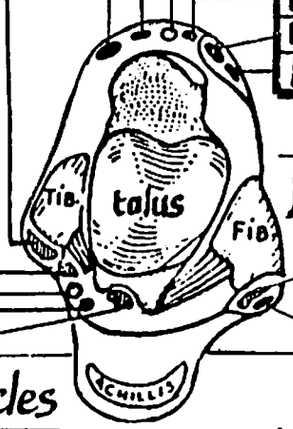
Posteromed. : Structures deep to flex. retinac.

Tibialis post	Tom
ext. Digitorum longus	Does
Post. tibial Vessels	Very
» » Nerve	Nice
Flexor Hallucis longus	Hats

Anteriorly : Structures deep to ext. retinac.

Tom	Tibialis ant.
Has	ext. Hallucis longus
Very	ant. tibial Vessels
Nice	ant. » Nerve
Dog	ext. Digitorum longus
Pig	peroneus tertius

T.S in the ankle →



Post-lat. : Structures deep to peroneal reti

(1) peroneus brevis tendon.

(2) » longus » .

VI – Movements allowed & muscles responsible :

(A) Dorsiflexion (extension) : is done by
- (1) tibialis anterior m. (chief musc
- (2) extensor hallucis longus m.
- (3) » digitorum » ».
- (4) peroneus tertius m.

(B) Planter flexion (Flexion) : is done by
- (1) gastrocnemius } chief muscle.
- (2) Soleus muscle }
- (3) plantaris.
- (4) tibialis posterior.
- (5) Flex. hallucis longus.
- (6) » digitorum » .

VII – Nerve Supply : branches from the deep peroneal & tibial nerves.

VIII – Blood Supply : from the anastomosis around ankle (see page 83).

Joints of the foot

(1) Subtalar (talo-calcanean) joint:

I- Type & variety: modified plane synovial joint

II- Articular surfaces:

(a) the lower articular surface of the body of talus &
(b) the post-convex facet on the upper surface of calcaneus

III- Capsule:

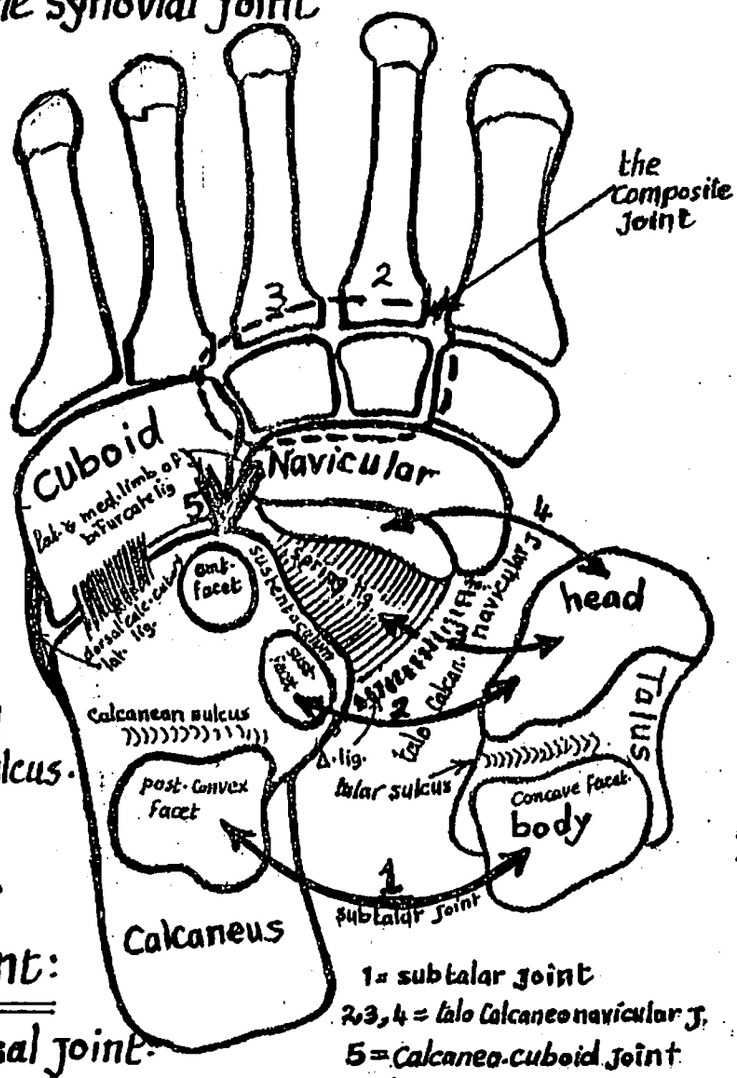
attached to the margins of the articular surfaces of both bones.

IV- Ligaments:

the most important lig. is the interosseous talo-calcanean lig. extending between the calcanean sulcus & talar sulcus.

V- Movements:

eversion & inversion (see page 123).



(2) Talo-Calcaneo-navicular joint:

* it is the med. part of the midtarsal joint.

I- Type & variety: synovial, modified type of ball & socket.

II- Articular Surfaces:

(1) the ball: is formed by the head of the talus

(2) the socket is formed as follows:

(A) inferiorly by: (a) Calcaneus (one facet on the upper surface of the sustentaculum & the other on the ant.-part of upper surface of calcaneus
(b) by the med. limb of bifurcate lig. (between upper surface of calcaneus & lat.-surface of navicular).
(c) the spring lig. (plantar Calcaneonavicular lig.).

(B) Anteriorly: by the facet on the back of navicular bone.

(C) Medially: by the ant.-part of the deltoid lig.

(3) The Calcaneo-cuboid joint :

* it forms the lat. part of the mid tarsal joint.

I- Type & variety : synovial, saddle.

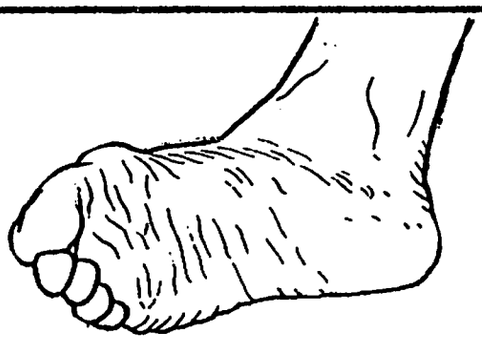
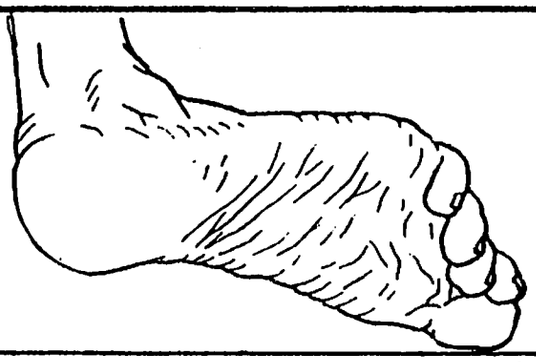
II- Articular surfaces : (a) the ant. surface of calcaneus (posteriorly) &
(b) " post. " " cuboid (anteriorly).

III- Capsule : attached around the margins of the articular surfaces.

IV- Ligaments:

(1) lat. limb of bifurcate lig.
(2) short plantar lig. (plantar calcaneo-cuboid lig.).
(3) long plantar lig.
(4) dorsal calcaneo-cuboid lig.

Inversion & Eversion

	Inversion	Eversion
		
Definition	- it is the movement of turning the sole of the foot medially - it is usually accompanied by slight plantar flexion of the ankle.	- it is the movement of turning the sole of the foot laterally - it is usually accompanied by slight dorsiflexion of the ankle.
Joints concerned	(1) the sub-talar (talo calcanean) joint. (2) the talo-calcaneo-navicular J. (med. part of the mid tarsal joint). (3) " calcaneo-cuboid joint (lat " " " " " ").	
Muscles acting	(1) Tibialis anterior (2) Tibialis posterior	(1) peroneus longus. (2) " brevis. (3) " tertius.
Factors limiting	(1) tension of the peroneal muscles (2) tension of the interosseous talo-calcanean lig.	(1) tension of tibialis ant. & post. m. (2) " " the deltoid lig.

	Inversion	Eversion
axis around which movements occur	passes obliquely upwards, forwards & medially from the back of calcaneus to a point just medial to the neck of talus	
Mechanism of the movement	the talus is fixed (by the 2 malleoli) while the calcaneus and the navicular bones swing around it carrying the other bones of the foot with them.	
N.B	(1) Eversion & inversion do not occur at the ankle joint (2) " " " occur mainly during walking on rough ground.	

(4) The Composite joint

* It is the joint between the navicular, the cuboid, the 3 cuniform bones & the bases of the 2nd & 3rd metacarpal bones
* All these articulations have one joint cavity.
* the movements allowed are of the gliding type & give flexibility to the foot.
* the bones are connected by plantar & dorsal ligaments as well as by short interosseous ligaments.

(5) The tarso-metatarsal (T.M) Joints

(1) the T.M joint of the big toe (cuneo-metatarsal J.) is an independent joint.
it is a plane Synovial joint.

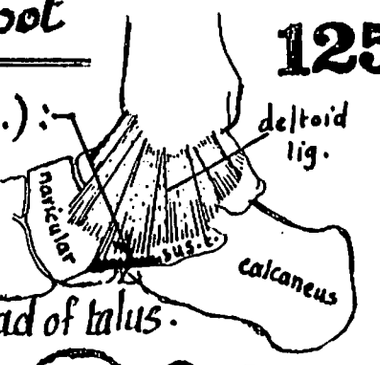
(2) the T.M. (cuneometatarsal joints) of the metatarsals 2,3 are parts of the composite joint (plane synovial).

(3) the T.M of the 4th & 5th metatarsals is the cubometatarsal joint.

(6) The metatarso-phalangeal (M.P) joints
(7) " Inter-phalangeal (I.P.) joints

are similar in type & movements to those of the hand.

Ligaments of the foot



(1) Spring ligament (plantar calcaneo-navicular lig.) :-

* it is a strong lig. which fills the gap between the sustentaculum tali & the navicular bone.
* it is so called because it acts as a spring below the head of talus.

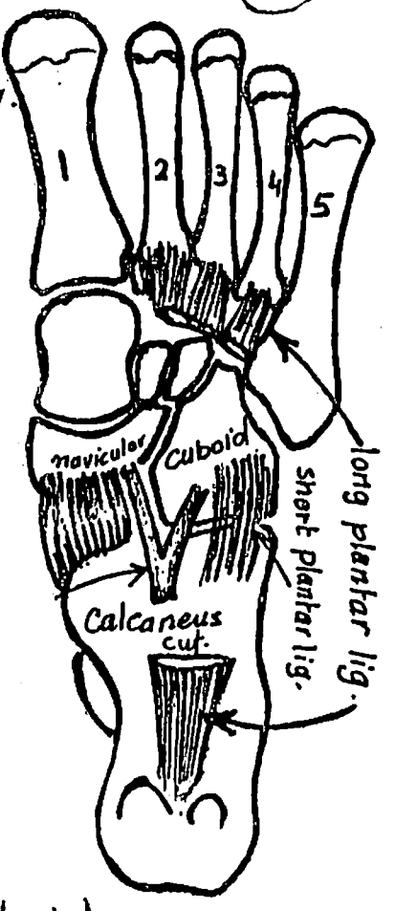
* **Attachments :**
 - posteriorly : to the ant. margin of the sustentaculum tali.
 - anteriorly : " " plantar aspect of navicular bone.
 - its med. border : blends with the deltoid lig

 N.B : the deltoid lig. braces the spring lig. upwards.

* **Relations :**
 (1) its upper surface is smooth & forms part of the socket of the talo-calcaneo-navicular joint.
 (2) its lower surface is supported by the tibialis post. & flexor hallucis longus tendons.

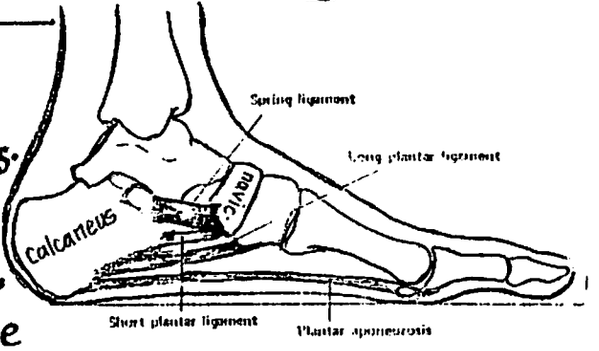
* **Importance :**

 it maintains the med. longitudinal arch of the foot by filling the gap between the sustentaculum tali & the navicular bone thus it supports the head of talus



(2) Long plantar lig.

* it is the longest & strongest of the tarsal ligs.
* its narrow post. end is attached to the plantar surface of calcaneous infront of the med. & lat. tub.
* its broad ant. end is attached to the bases of the 2nd, 3rd & 4th metatarsal bones.
* it crosses the plantar surface of cuboid bone converting its groove for the peroneus longus into a tunnel.
* it is important in maintaining the med. longitudinal arch of the foot.



(3) Short plantar lig. (plantar calcaneo-cuboid lig.) :

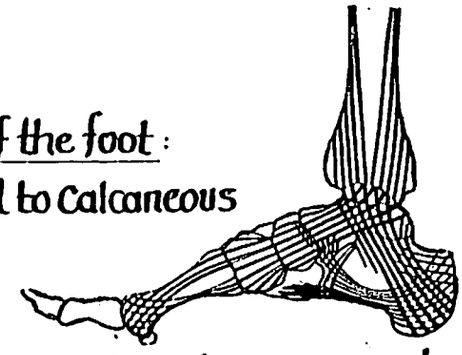
- it connects calcaneus & cuboid & maintains the lat. longitudinal arch of the foot.

(4) Bifurcate lig. : it is V-shaped lig., attached posteriorly to plantar surface of calcaneus & divides in to med. slip attached to navicular & lat. slip attached to cuboid.

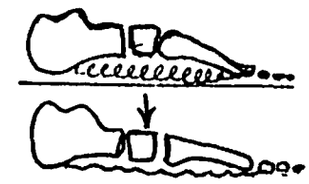
Arches of the foot

* **Definition** : the human foot is built in such a way that its bones form arches which do not come in contact with the ground when the weight of the body is born on the feet during standing .

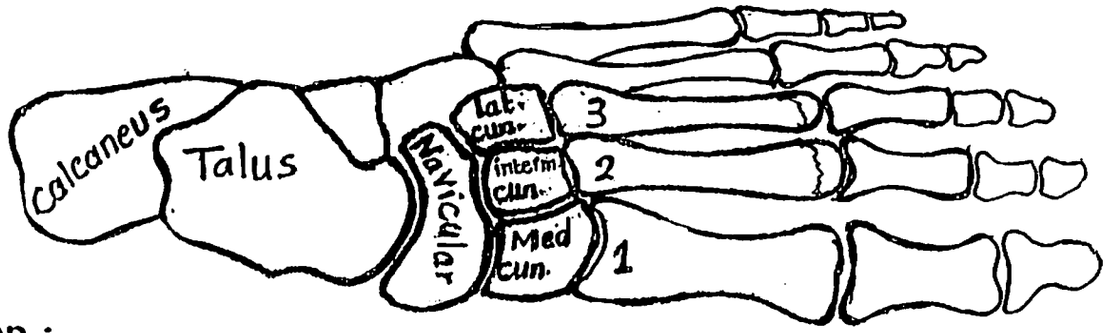
* **Classification** : the arches of the foot include :
 (1) The medial longitudinal arch : along the medial border of the foot
 (2) The lateral longitudinal arch : along the lateral border of foot & more depressed than the medial one .
 (3) The transverse arch : is marked at the bases of metatarsal bones .



* **Functions of the arches of the foot** :
 (1) Distribution of the body weight on the bones of the foot :
 ½ of the weight reaching the talus is delivered to Calcaneous while the other ½ is transmitted forwards from talus to be distributed equally to 6 points (lateral 4 metatarsal heads + 2 sesamoid bones under the head of the 1st metatarsal.
 (2) Giving the foot elasticity & reselience of movement during locomotion
 (3) Absorption of shocks when falling on the feet
 (4) Adaptation of the foot to irregular or sloping surfaces
 (5) Protection of the plantar n. & vessels.



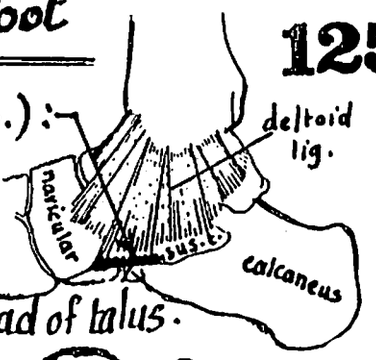
(A) The Medial longitudinal arch



I- **Construction** :

* It is formed of 9 bones → Calcaneus , talus , navicular
 → the 3 cuniform bones
 → the med. 3 metatarsal bones

Ligaments of the foot



(1) Spring ligament (plantar calcaneo-navicular lig.):

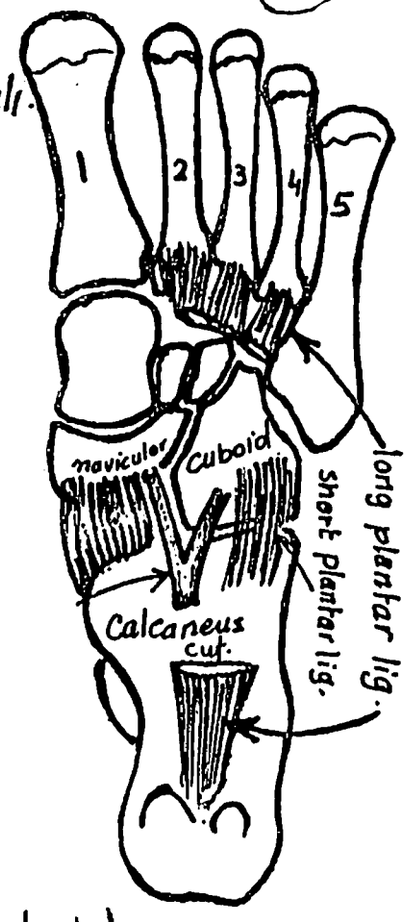
*it is a strong lig. which fills the gap between the sustentaculum tali & the navicular bone.

*it is so called because it acts as a spring below the head of talus.

*Attachments:

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*Relations:

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(2) its lower surface is supported by the tibialis post. & flexor hallucis longus tendons.

*Importance:

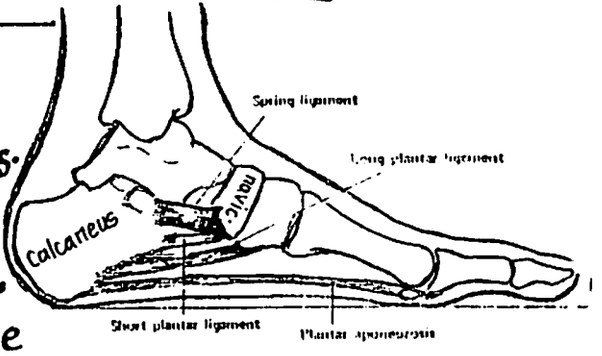
it maintains the med. longitudinal arch of the foot by filling the gap between the sustentaculum tali & the navicular bone thus it supports the head of talus

(2) Long plantar lig.

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*its broad ant. end is attached to the bases of the 2nd, 3rd & 4th metatarsal bones.



*it crosses the plantar surface of cuboid bone converting its groove for the peroneus longus into a tunnel.

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(3) Short plantar lig. (plantar calcaneo-cuboid lig.):

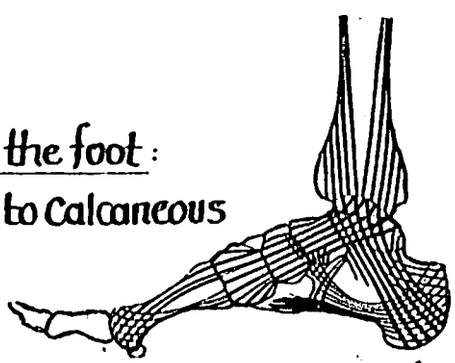
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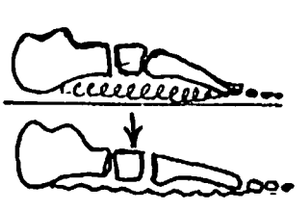
Arches of the foot

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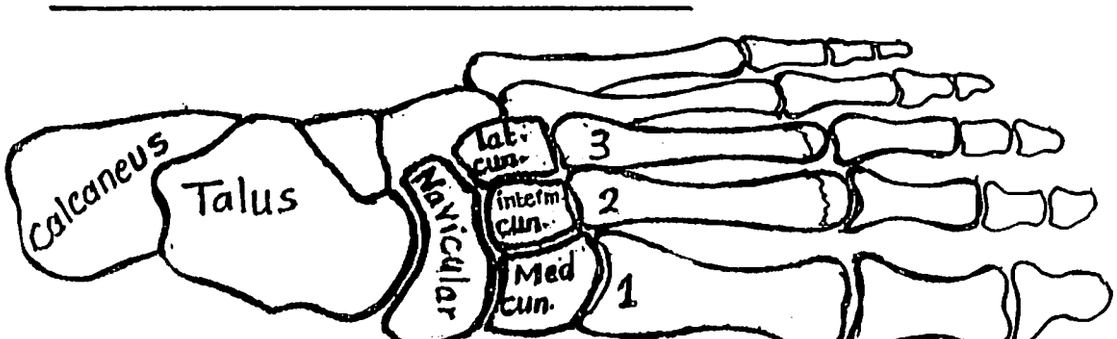
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 (4) Adaptation of the foot to irregular or sloping surfaces
 (5) Protection of the plantar n. & vessels.



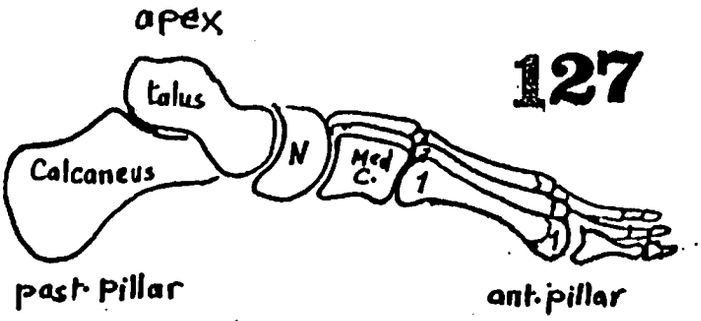
(A) The Medial longitudinal arch



I- Construction :

* It is formed of 9 bones → Calcaneus , talus , navicular
 → the 3 cuniform bones
 → the med. 3 metatarsal bones

II- Shape: It is arched upwards, having:



1) Post. pillar: (the point touching the ground behind) which is the Calcanean tuberosity.

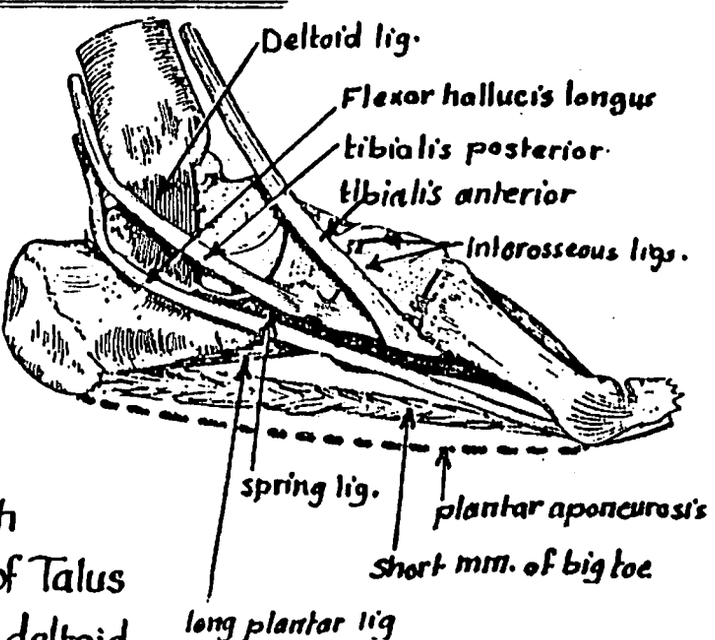
2) Ant. pillar (the point touching the ground anteriorly) & formed by the heads of the med. 3 metatarsal bones.

3) Apex (the highest point of the arch) is formed by the Talus.

III- Function: the med. longitudinal arch is concerned with the elastic propulsion of the foot during walking.

IV- Factors maintaining the med. longitudinal arch:

1) Bony factors:-
the construction of the bones is designed in such a way that when they articulate they form an arch.



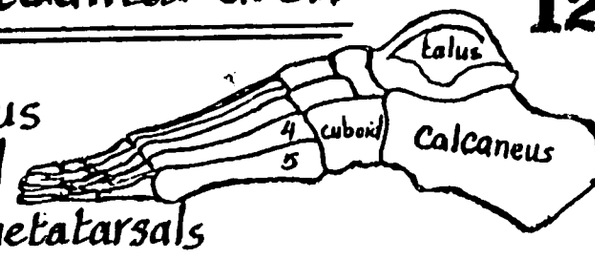
2) Ligaments:-
(a) the Spring ligament: supports the summit (apex) of arch by bridging the gap below head of Talus
(b) the Deltoid lig.: by bracing the deltoid lig. upwards & supporting the Talus (which is the Keystone).
(c) the Interosseous ligaments: binding the bones together.
(d) the Long plantar ligament
(e) the Plantar aponeurosis
} by holding the ant. & post. pillars of the arch.

3) Muscles:

(a) tendons of → Tibialis anterior.
→ Tibialis posterior.
→ Flexor hallucis longus.

(b) the tone of the short muscles of the big toe.

B- The Lateral Longitudinal arch



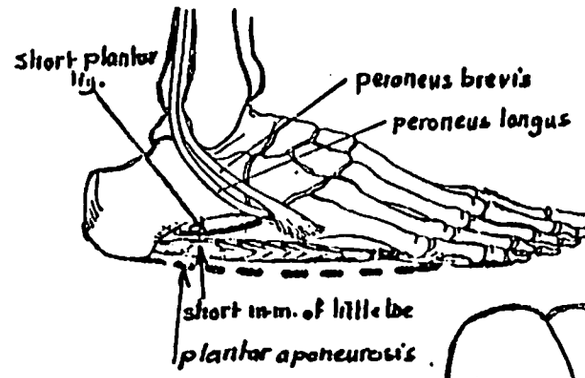
I-Construction:
it is formed by 4 bones: calcaneus, cuboid, lat. 2 metatarsals

II-Shape: it is not as high as the med. arch.
(1) its post. pillar is formed by the calcanean tuberosity.
(2) its ant. " " " " the bases of the 4th & 5th metatarsals.
(3) its apex is formed by the cuboid bone.

III-Function: it is concerned with the support of the body weight during standing (static arch).

IV Factors maintaining it:

(1) Bony factors: as in med. longitudinal arch
(2) Ligaments:
(a) the interosseous ligaments.
(b) " short plantar lig.
(c) the plantar aponeurosis.



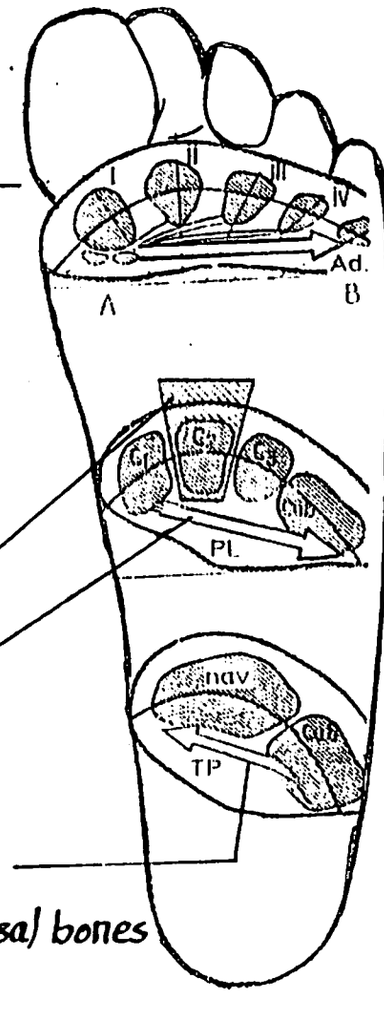
(3) **Muscles:**
(a) peroneus longus & brevis
(b) short muscles of the little toe

C-The transverse arch

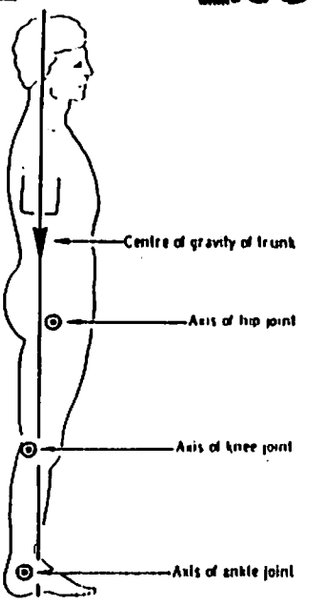
- it runs from side to side
- it is formed by the tarsal bones (cuboid & 3 cuniforms) + the bases of all metatarsal bones.

*** Factors maintaining it:**

(1) Bony factors: the wedge-shaped appearance of the intermed. & lat. cuniform bones
(2) Ligaments: the strong plantar interosseous ligs.
(3) Muscles:
(a) peroneus longus tendon (most important)
(b) the slips of tibialis post. tendon (pulling tarsal bones together)
(c) the transverse head of add. hallucis (by drawing the metatarsal bones



I- In the standing position:



* The weight of the head & neck, U.L. & trunk is transmitted through the vertebral bodies down to the 5th lumbar vertebra then delivered to the 2 hip bones through the sacro-iliac joints.
* Each ½ of the body weight is then transmitted via the dorsal segment of each hip bone to the acetabulum where it is delivered to the head of the femur at the hip joint.

N.B: the line of gravity passes behind the centre of the hip joint inducing hyperextension of that joint. This hyperextension is checked by the strong iliofemoral & pubofemoral ligs.

* The weight delivered to the head of femur is carried through the femoral neck (whose lower part is much thickened to support the femoral neck angle) then transmitted downwards through the shaft of the femur till its lower end.

N.B: the ant. convexity of the femoral shaft throws the line of the body weight infront of the axis of the knee joint inducing passive hyperextension which is checked by:

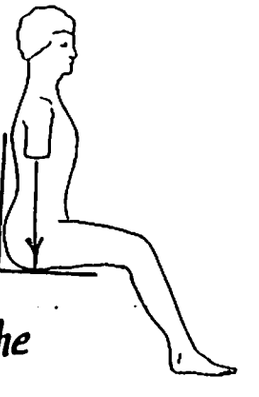
(1) the articular surfaces & the menisci of the knee joint.
(2) the tension of the collateral ligaments
(3) " " " " ant. cruciate lig.
(4) " " " " post. oblique popliteal lig.

* At the knee joint, the body weight is transmitted from the lower end of the femur, mainly through the lat. condyle, to the upper end of the tibia.
* the weight is then transmitted by the shaft of the tibia down to the ankle joint.

N.B: the line of the body weight falls infront of the ankle joint inducing hyperextension which is checked by the contraction of gastrocnemeus & soleus mm.

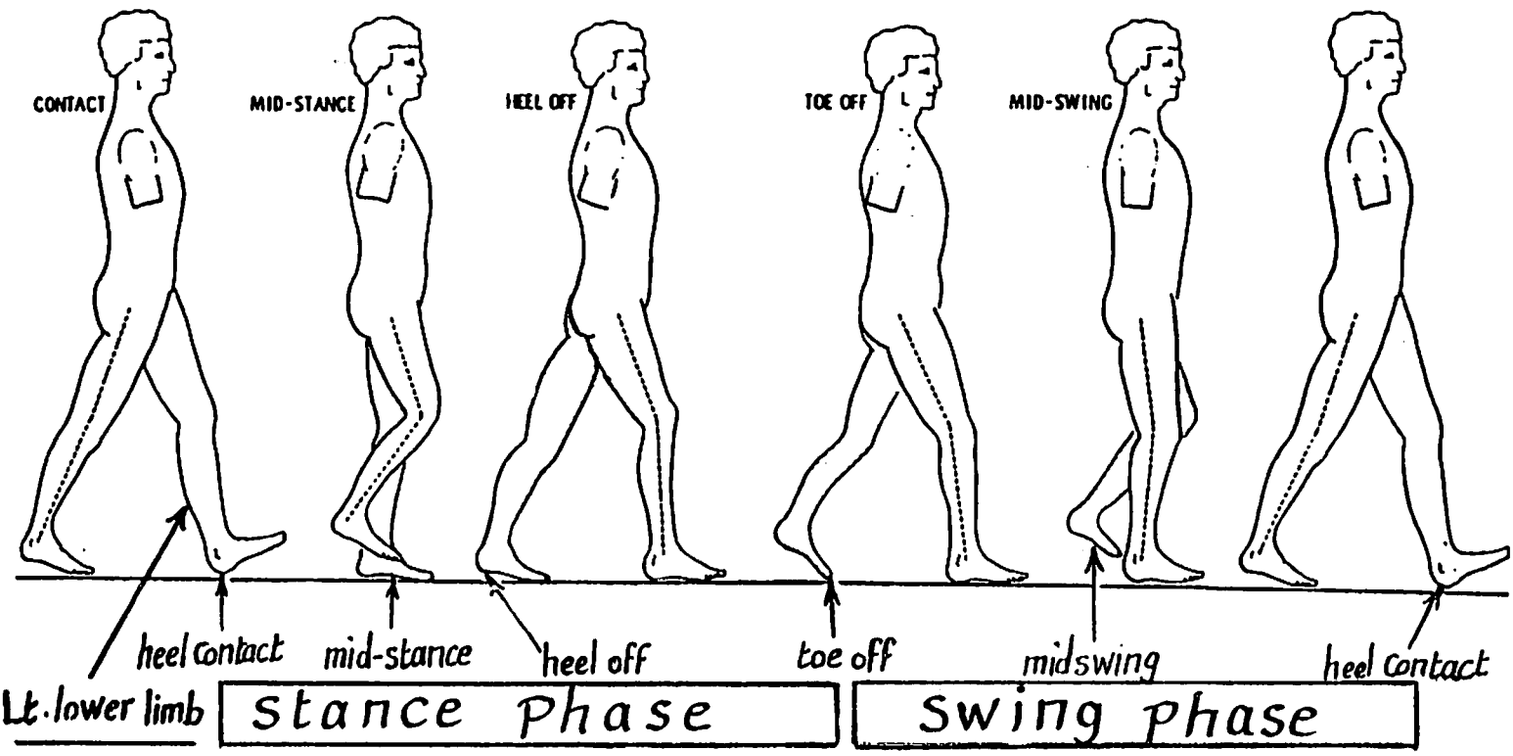
* The weight falling on talus divides into:
(1) a post. ½ which is transmitted posteriorly to the calcaneus.
(2) an ant. ½ " " " anteriorly along the cuboid & the lat. 2 metatarsal bones to the balls of the 4th & 5th toes.

II- In the sitting position:



the weight of the body is transmitted from the vertebral column via the sacro-iliac joints to the dorsal segments of the 2 hip bones then falls on the 2 ischial tuberosities which are the 2 bony parts supporting the body weight in the sitting position.

Mechanism of Walking



* Walking is a composite process consisting of series of steps.
* A complete step can be analysed into 2 phases → I- stance phase (3/5 of the cycle).
 → II- swing phase (2/5 " " ").

I- Stance phase: the limb is on the ground:

early stance: starts with heel strike which is the contact of the heel with the ground.

mid- stance: the weight of the body is transmitted forwards, along the lat. border of the sole, from the heel to the heads of the metatarsal bones

late- stance: the heel is elevated (by contraction of soleus & gastrocnemeus muscles) then the toes are raised from the ground (by contraction of the flexors of the toes). This is called toe-off which terminates the stance phase.

II- Swing phase: (the limb is off the ground):

- this phase starts by the toe-off accompanied by slight flexion of the hip & knee joints & dorsiflexion of the ankle joint. This flexion of the 3 joints helps in raising the foot more from the ground.
- the leg is then propelled forwards by the following sequence of movements:
 (1) more flexion of the hip (2) full extension of the knee
 (3) more dorsiflexion of the ankle (4) forward movement of the pelvis which pushes the extended leg forwards.
- the swing phase ends by heel strike when the heel comes in contact with the ground again.

Muscles keeping balance during standing

(I) Stability of the pelvis on the femur:

(A) during standing on both lower limbs, the stability of the pelvis is ensured by the combined action of the following muscles:

(1) the guy ropes (sartorius, gracilis & semitendinosus): they arise from 3 distant points in the hip bone but share a common insertion in the upper part of med. surface of tibia. They steady the pelvis on the head of femur.

(2) the sartorius & straight head of rectus femoris counteract the hyper-extension tendency of the hip joint.

(B) during standing on one limb only: the stability of the pelvis is ensured by the combined action of gluteus medius & minimus which prevent the tilt of the pelvis towards the unsupported side.

(II) Stability of the knee joint:

(1) the ilio tibial tract (which receives the insertion of tensor fascia latae m. & the superficial 3/4 of gluteus maximus), acts as a powerful brace which helps to steady the pelvis & keep the knee joint firmly extended.

(2) the quadriceps femoris m. contracts only when active extension of the knee is needed. In this respect it counteracts the action of the hamstrings & the gastrocnemius

(III) Stability of the ankle joint:

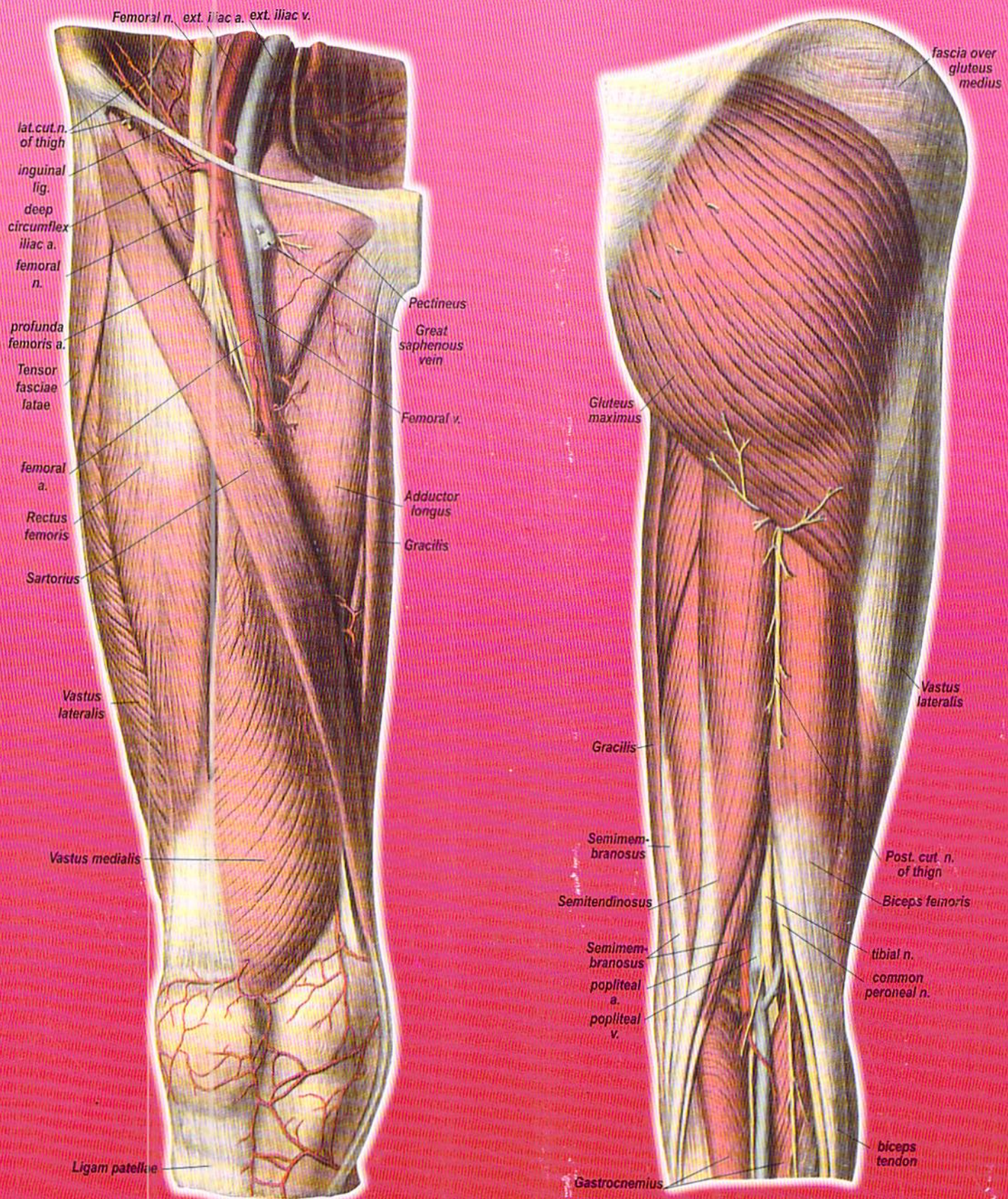
is ensured by the interaction between the ant. tibial muscles (dorsiflexors of the ankle), counter balanced by the action of the gastrocnemius, soleus & the long flexors of the toes

(IV) Tendency of the leg to shift laterally or medially:

is prevented by the contraction of the flexor tendons medially & the peroneal muscles laterally.

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Femoral n.
ext. iliac a.
ext. iliac v.
lat.cut.n. of thigh
inguinal lig.
deep circumflex iliac a.
femoral n.
profunda femoris a.
Tensor fasciae latae
femoral a.
Rectus femoris
Sartorius
Vastus lateralis
Vastus medialis
Ligam patellae
Pectineus
Great saphenous vein
Femoral v.
Adductor longus
Gracilis
fascia over gluteus medius
Gluteus maximus
Vastus lateralis
Gracilis
Semimem-branosus
Semitendinosus
Semimem-branosus
popliteal a.
popliteal v.
Post. cut. n. of thigh
Biceps femoris
tibial n.
common peroneal n.
biceps tendon
Gastrocnemius